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Re-treating Tailing at the Replogle Plant

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A WEEKLY JOURNAL REPRESENTING THE WORLD'S MINING AND METAL INDUSTRIES

May 12, 1923

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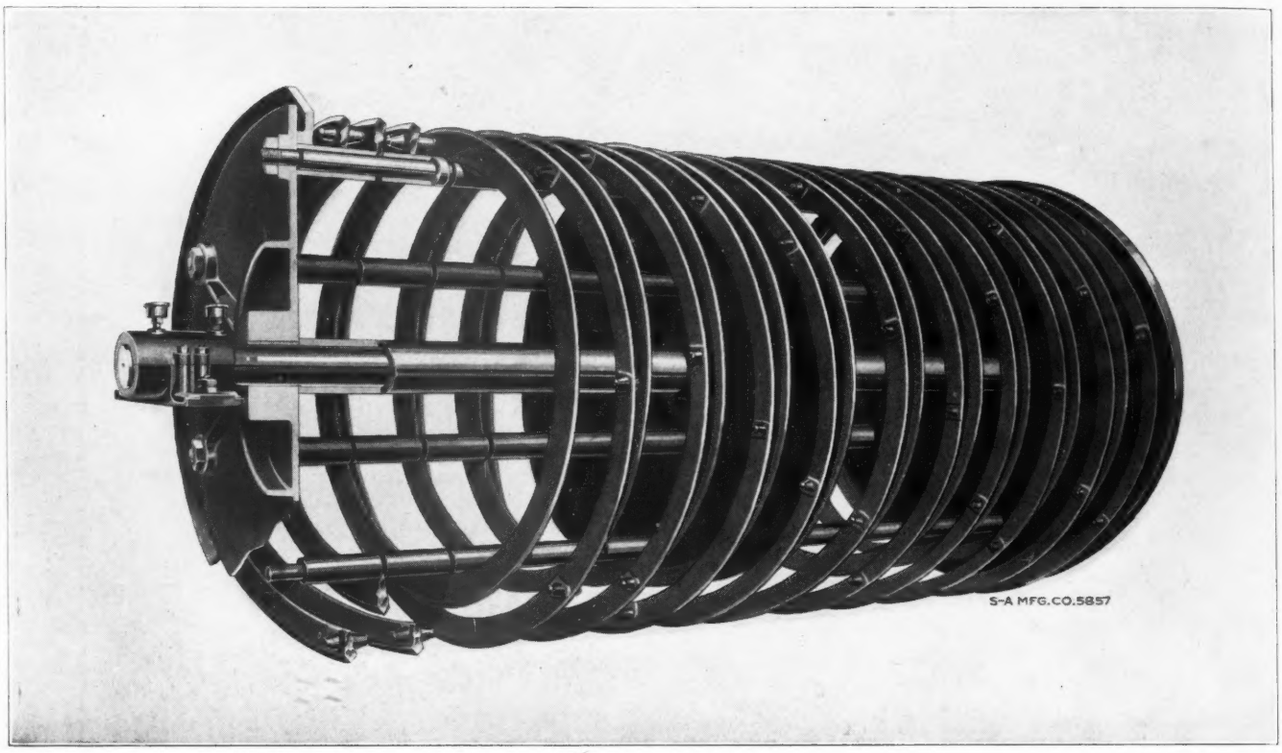

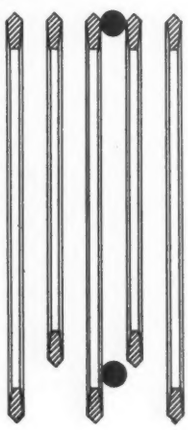

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ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

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Caterpillar Shovels

FIFTEEN YEARS AGO the 3½-cu.yd. steam shovels used by the Utah Copper Co. at its open-cut mines at Bingham were considered to be marvels of efficiency; indeed, it would be inaccurate to imply that they are not, today, economical machines for loading newly blasted rock into railway cars. This fact merely emphasizes the progress that is being made in developing even more efficient equipment. Several features of new shovels just ordered by the Utah company are noteworthy. For one thing the dippers have a capacity of 4½ cu.yd. It would be interesting to know what conditions made it seem inadvisable to select 6-yd. dippers such as are used at Chuquicamata and elsewhere. Another feature is the use of electricity as the motive power instead of steam. The advantages are numerous. The supplying and distribution of coal and water is eliminated; likewise the wages of a fireman, and the periodic washing and repair of boilers. The operation of the shovels is more or less intermittent, and it costs money to keep up steam or else delay is entailed in waiting for it. Electric energy is more flexible. The cost of the installation and upkeep of an electric distributing system on the various benches in the mine will be small compared with the savings effected. Both coal and electric power are comparatively cheap in Utah, so that the principal economy will arise from operating advantages.

Perhaps the most interesting change is the mounting of the shovel on a caterpillar tractor instead of on railroad trucks. Heretofore it has been customary to run heavy steam shovels either on a single standard-gage railroad track or on two tracks paralleling each other at a distance of about 25 ft. For several years light shovels of small capacity have been constructed with tractor bases, but the design of a caterpillar shovel of the size used by the Utah Copper Co. is a comparatively recent departure. When railroad tracks are used a crew of four men is employed constantly in preparing the grade and shifting from the back to the front of the shovel the short lengths of track upon which it runs. This work will be entirely eliminated with the new machines. Great flexibility in operation is obtained by using shovels of the new type. Incidentally the development and improvement of large caterpillars is intimately connected with the war; the tanks that played so prominent a part on the battlefield were a notable application of the caterpillar principle.

It hardly seems possible that the reason for using 4½- instead of 6-yd. dippers is that the resulting machine would be too large to be operated efficiently on a caterpillar base, but under the particular conditions prevailing at Bingham that may be the determining factor. After careful experimentation with remodeled machines the Utah company ordered two shovels of the new type, and the announcement is made that shovel equipment bought in the future will be of this kind. A mental reservation might be made to this effect: Until some better machine for the work is satisfactorily developed.

In these days when wages are high and workers are scarce conditions are ideal for the introduction of new and novel labor-saving machines, and the best of equipment is likely at any time to find itself relegated to the obsolete.

Exploring the Earth's Crust

IT IS CLAIMED that the deepest hole in the world is a diamond-drill hole in the Upper Silesia coal field —in that portion of it which still belongs to Germany. The depth of this hole is 7,350 ft. In Pennsylvania, near McDonald, a drill hole, or "well," which is being sunk for oil, was recently at a depth of 7,174 ft.

The deepest mine in the world, as has been stated many times, is the St. John del Rey, in Minas Geraes, in Brazil, which has attained a vertical depth of 6,426 ft. The Ooregum mine, in India, is 5,400 ft. deep, vertically; and in South Africa there are several shafts over 5,000 ft. deep.

How deep is it possible to penetrate the crust of the earth? Physicists and geophysicists have made calculations, which have so many possibilities for error that they may after all be ranked as surmises. Van Hise estimated that at a depth of 5.9 miles all openings would be closed by rock flowage, so that the walls of a shaft or other hole at this depth would close by flowage; later Dr. Frank D. Adams stated as the result of experiments that some openings could exist up to a depth of 11 miles.

The result of experiment, reason, and conjecture as to conditions of pressure and temperature as distance downward from the earth's surface is gained is quite unsatisfactory, being contradictory and insufficiently determined. Actual observation, if possible, would be far more reliable. Such observations in mines have shown, for example, that there is no fixed increment of temperature with depth, for while the average increment is stated at 1 deg. F. per 64 ft., in the Comstock and in the Tonopah mines, both in Nevada, the increment is 1 deg. F. per 33 ft. of depth. These last are in regions of Tertiary volcanism. As to pressure in depth, actual observation would certainly also show great differences. Where the rocks lie horizontal and undisturbed, observation would show little more than gravity pressure to reckon with; but in regions of folding, faulting, and intrusion the strains are probably still unbalanced, and openings would be crushed shut (even if not flowed shut) far more rapidly than in the former case. Existing deep mine shafts in various parts of the country afford the geophysicists an opportunity actually to determine by experiment and observation many of these differences and their import.

It is rather remarkable, in these days of "records," that some mining millionaire has not bequeathed a

great sum to the scientific enterprise of sinking a shaft as deep as could be sunk. A sum sufficiently large so that the interest would prosecute the work indefinitely would be ideal. Such a man would leave an appropriate, unique, and abiding monument to his name; and one more original than could be had by founding a library or university.

We are insatiable explorers. We have explored the earth's surface and the skies for science' sake; but we have not yet explored the inner earth for the sake of science and scientific adventure.

Synthesis and Transmutation

SPORADIC REFERENCE in newspapers to the possibility of manufacturing "synthetic" gold occasions alarm among gold miners; but it is fitting to observe that a careless use of terms invariably indicates an ignorance of the subject under discussion. Hence all newspaper comment that discusses seriously the subject of "synthetic" gold can be dismissed as unworthy of more than cursory attention. Synthesis implies the union of two or more elements. Gold is an element—as are all the other metals—so it cannot be synthesized.

The metal miner need fear nothing from the discoveries of science. In this respect he is in a more fortunate position than the miner of compounds, many of which can be manufactured synthetically. However, the economic aspect is important. Successful technology does not always connote commercial supremacy. The present position of the industries concerned with the synthetic manufacture of nitrate, camphor, and indigo constitutes an indication of successful research and technical development against economic odds too strong to be overcome.

Transmutation, which may be defined as a natural and little-understood change, whereby an element is transformed into another element, is an accepted fact, the realization of which is one of the outstanding achievements of modern science. Satisfactory proof has been forthcoming that the vaporings of the alchemists antedated scientific discoveries that would have filled them with awe. So far, it has been found impossible to control or to stimulate the change, but it has been demonstrated that uranium and thorium, for instance, may be transmuted, with lead as the final product. It is not improbable that lead may be transmuted into gold; but experience has shown that this would involve an amount of energy out of all proportion to the value of the ultimate product. In fact, gold miners will be cheered to know that a reverse process may prove to be the more practicable: the changing of gold into lead may be profitable because of the release of energy that always accompanies the change.

Mining the Non-Metallics

IN THE EXPLOITATION of mineral resources to obtain metals, the establishment of a profitable enterprise depends in large measure on the finding of a deposit in which the valuable mineral is sufficiently concentrated. In the realm of the non-metals the problem is often more complex; regions of concentration must be found, the mineral must possess the requisite chemical qualities, and in addition specific physical properties may be demanded. The physical requirements are of particular importance in the minerals or rocks that are fabricated into finished forms without the aid of chemical or heat treatment. A marble must not only be a pure carbonate of lime or magnesia, but must also possess certain qualities of structure, crystallization, color, and uniformity. With mica, concentration is only a fraction of the problem; the percentage of mica in a vein may be high, but the deposit may be worthless, for commercial material must be in sheets of a specified size. It must split freely; it must be reasonably free of impurities, cracks, pinholes, or plications. An impure metal may be purified, but an impure or otherwise defective mica has so far defied the skill of man to give it the qualities demanded for the higher uses.

Thus with the non-metallic minerals, as with the metallic ores, the first step in exploitation is to find a concentrated or reasonably pure deposit; but such a discovery may not complete the search. Thereafter comes the long and tedious second process of obtaining, along with concentration, a series of definite physical qualities. When a deposit is found which sufficiently approximates the requirements of use to justify development, the operator must take a third step, involving the complex problems of efficient utilization.

Nature's fabrication can be little changed; for the most part man must take the non-metallic minerals or rocks as he finds them. Many operators have accepted this condition too unquestioningly, and have failed to realize that man is not entirely helpless; they have often overlooked the possible control of the finished product.

The complexities of non-metallic deposits have never been given sufficient study. It is often possible to modify mining methods in such a way as to minimize the detrimental effects of imperfections. The failure of some operators of dimension-stone quarries to make their cuts parallel with joint systems or other structural features has injured the value of their products. With certain minerals or rocks a careful study of the qualities and adaptability of products from different parts of a deposit may make it possible to prepare a series of graded products with a net average value greatly enhanced when compared with that of less carefully selected materials.

In bedded deposits, such as limestone, variations in quality commonly occur in passing from one zone of deposition to another. Insufficient study has been given to methods of equalizing these differences so as to obtain a uniform product of lime or of segregating rock from the various beds for the manufacture of a series of special products. Improper classification has likewise constituted a serious problem for users of feldspar. The charge has often been made, and justly, that certain domestic non-metallic products such as clays and whitings fail to measure up to the standards of imported materials. The chief complaint is of lack of uniformity in domestic graded products. There is a tendency in America to accomplish things on a large scale, to measure results on a quantitative basis, but to neglect in some branches of industry the thoroughness and the careful regard for detail which characterize the operations of some foreign concerns that have built up an enviable reputation through centuries of efficient service. The time has come to correct this.

Are the defects of natural deposits to be perpetuated in the finished products, or will enterprise and invention find ways of overcoming their ill effects? Some

good work has already been done in segregating and rejecting imperfect or impure material, and in grading products rigidly according to their qualities and adaptabilities, but the untrodden field is very broad.

Why should American producers stand helpless while the inherent defects of raw materials are transmitted to finished products? Unfortunately, many operators are not yet aroused to the need of better methods; but when this awakening comes a long step will have been made toward improvement.

Miners Meet at Sacramento

THE Sacramento Chamber of Commerce called upon the mining men of California and Nevada to attend a conference on April 20, 1923. More than 100 mining men gathered. An excellent program was arranged by the Chamber. In the general discussion which followed the presentation of several papers the difficulties which beset the miner were brought out. These were, restrictive and regulative legislation, excessive cost of complying with the blue-sky law, need for capital for prospecting and small mine operation, high taxes paid by mines in sparsely settled counties, activity of the railroads in patenting lands between and near mining areas, labor inefficiency and turnover, and the need for a clearing house between owners and purchasers of mining property.

The Sacramento Chamber of Commerce has established a department of mines and mining, and this department will co-operate with mining men in revitalizing the mining industry. The realization by business men of the important relation of mining to the prosperity of cities and towns tributary to mining districts, and the co-operation of business men with mining men in an endeavor to better the conditions of the mining industry, are significant of a new and valuable point of view.

The Overestimation of Geologic Skill

UNDER THE ABOVE CAPTION some time ago we discussed the lack of accurate ideas among the laity as to the degree of preciseness with which geology could be applied to mining. Those remarks did not have reference to overestimation of his skill by the geologist himself, but by those who did not have an adequate geologic training. We have just had our attention, however, called to a case where the geologist publicly overestimates himself. A circular sent out by a gentleman who writes after his name A. O. S. M. (whatever that may mean) makes the following statement:

> "The latest researches in Vulcanology, Tectonic and Economic Geology are rapidly simplifying the problems of ore deposits in Volcanic regions. From purely a surface examination it is possible today in nearly all cases,
>
> (1) To determine the boundaries of the Mineralized Zone.
>
> (2) To locate the principal ore-shoots.
>
> (3) To determine the more valuable portion of an ore-body.
>
> (4) To give an estimation of the producing possibilities of Prospects or New Fields."

In comment, it may be plainly said that the quoted statements are not true. From a surface examination it is not possible in nearly all cases to determine the four important problems stated, or indeed any but the very first factor, which, indeed, is a matter of mere observation open to most: that is, we have never known or heard of anyone who has these peculiar powers of diagnosis with which this gentleman credits himself. And, indeed, the "latest researches in Vulcanology, Tectonic and Economic Geology" are showing how complex is the problem of ore deposition, and how each factor must be detected and evaluated with all the skill and balance possible, and with all the evidence gathered on the surface, and especially underground, which can be obtained, before an opinion can be rendered, which will be a qualified opinion, depending upon the complexity of the case and the availability of adequate evidence.

The author of the circular prints references from various men of high standing, of which he says, "The scientific standing of the above men may be ascertained by reference to any large Scientific Society or Institution. Papers, Bulletins or Textbooks written by them can be consulted in any Scientific Library throughout the world." And this statement is correct. But all the more should the geologist, if he have training and ability, refrain from

> "Talkin' tall and tactless, as saints hadn't orter."

And although neither degrees nor societies have ultimate significance, he should seek membership in one or more of the mining and geological societies where the contact would help.

Moisture in Silver Bullion

METALLURGISTS who appreciate the need for accuracy in the estimation of the amount of precious metal in bullion will be interested to learn of developments that occurred recently at one of the important United States mints. It was the custom to warm the bar of silver on the top of the furnace preparatory to placing it in the crucible, a practice that had on several occasions resulted in an explosion. In one instance, a workman was injured by a piece of metal that was found to have come from the side of a bar. The problem eluded solution for some time, until moisture was noticed in a cavity on the surface. Further investigation revealed the fact that the bars as purchased, all of which had been quenched in water in the usual manner, had retained an appreciable amount of moisture. One estimation showed 0.92 oz. per 1,100 oz.; this gives an idea of the absorptive character of the average ingot. The correctness of the conclusion was demonstrated and accepted, and the consignor of the metal agreed to a deduction on the shipment of 0.3 oz. per bar.

These data are unimportant, but the incident serves to draw attention to yet another factor that influences the problems of determining exact weight and avoiding complications with buyers. It is probable that the quenching in water of silver bars may be prohibited in the interest of safety. This will cause little inconvenience to producers of high-grade metal; but with base bullion, quenching in cold water serves to facilitate the removal of undesirable accretions of slag and matte. With such a product, however, it is sometimes possible to improve the appearance and remove adhering waste by scratching the surface vigorously with a wire brush as soon as the bar has set, and while the silver is still red hot. The trouble incidental to quenching in water may thus be avoided.

DISCUSSION

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

The Klondike Discovery

THE EDITOR:

Sir—I am loath to revive an old controversy about the Klondike discovery, but I would appreciate the favor if you would grant me space to reply to Dr. A. E. Wills' communication in your issue of Feb. 17.

Now as to the facts: Obviously, I do not know of my own knowledge the actual details of the discovery, as I was not present. Neither was Dr. Wills. My version came from Carmack himself, personally. That Henderson, who was an avowed enemy of Carmack's, may have given Dr. Wills an entirely different story is quite possible.

As to the gold panned on Discovery rim, I can only say that when, on or about the twentieth of August, I arrived in Forty Mile on the steamboat "Alice" from Circle City, there was no question among the old-timers as to the amount of gold that Carmack had shown about town, as most of them had seen it, and it was known, besides, that he had bought a substantial "outfit" of provisions from the A. C. Co., and had paid for it in gold dust. But it is also quite true that at that time there was considerable skepticism as to the genuineness of the strike, and that many believed that Carmack was trying to create an excitement for the benefit of his friend Joseph Ladue, who was then on the point of moving his trading outfit to the mouth of the Klondike from the Sixty Mile post. On the other hand, to anyone familiar with the psychology of those skeptical, hard-boiled old-timers, who had so often been deceived by fake strikes, the assumption that $2 or $3 worth of gold would stampede them 50 miles up the swift Yukon to a locality in which they had no confidence is absurd.

Carmack's account of the recovery of that $700 from the Discovery rim, as given to me in George Westbrooks' cabin, in the early part of December, was that, with the help of the squaws, the overburden, about 2½ ft. thick, had first been stripped off down to the rich dirt immediately overlying bedrock, and that this rich dirt, together with a few inches of the bedrock, had then been carefully scraped into a gunny sack and dragged down to the edge of the water where the men had taken turns about at panning. When the spot was pointed out to me a couple of days later I roughly estimated the area worked over to contain approximately 40 sq.ft. of bedrock. Yet, rich as this bench was, it was as nothing compared to the extremely rich ground afterward found in the vicinity, notably on the Dick Lowe fraction, where I saw pans ranging up to $100 in value taken from bedrock the following summer.

Has Dr. Wills never heard of the miles of benches on the Klondike creeks, where the paystreaks, in many instances, rivaled in richness those of the creek bottoms? And what are benches, often erroneously called rims or bars by miners, but the ancient channels or stream beds of a former level of erosion?

The date of location on Discovery claim, written in large letters on a lone, blazed spruce that stood close to the bank of the creek, was July 26, 1896, as anyone who ever traveled up Bonanza during the first two winters, when the trail lay over the frozen stream bed, could easily see for himself. That location notice held a peculiar fascination for me and I examined it time and again.

When I first visited Bonanza on Dec. 5, pay had been found at various localities for a distance of almost 9 miles up and down the creek, or to be specific: from No. 26 Above, where a crosscut had revealed a paystreak 200 ft. wide, to No. 60 Below. But the richest pay was above Discovery, notably on 21 above, where Louis Rhodes, with whom I spent the night, was taking out a dump that had, even then, assumed goodly proportions. It was a matter of common knowledge that he had found pans worth as much as $60. Eldorado was also known to be extremely rich at that time.

How amusing to an old prospector is Dr. Wills' assumption that nearly the entire male population of Forty Mile, besides a steamboat load ("The Arctic") from Circle City, would stampede to the Klondike creeks; use their valuable rights of location by staking claims; return to Forty Mile for supplies, then go back, mostly by poling boats, to the mouth of the Klondike, and from there, pack or drag their expensive outfits to the creeks; build cabins, etc., and all this hardship, expense and heart-breaking labor before pay dirt of any kind had been found by anybody!

When I spoke rather carelessly of the squaw men "on the Yukon," meaning thereby, as was the custom, the Yukon River country as distinguished from Yukon Territory (a political division, carved out of the Canadian Northwest Territories and established a year or two later), I had in mind the forty-odd squaw men whom I knew personally between Circle and Pelly. Of that number, however, I unfortunately recollect the names of only twenty-five. To anyone interested I'll gladly furnish a list of these upon request. Of ten traders on the upper river, seven had native wives, and surely such men as Harper, McQuesten, Mayo, and O'Brien, among others, were highly respectable. Two bishops were on the Yukon in 1896. One, Bishop Rowe, who was then a vigorous young man, still makes occasional trips to Alaska, where he is highly esteemed. My reference, however, was to Bishop B., a very seedy, rather feeble oldish man, who had a large family of half-breed children.

ALEX. MCCOMBER.

Anchorage, Alaska.

THE EDITOR:

Sir—I had hoped that further discussion on my part with regard to the Klondike discovery had ended, but, having been shown Mr. George Clarke's article, I am persuaded to encroach further upon your good nature.

With regard to the exact distance in an air line between the two discoveries of Henderson on Gold Bottom and Carmack on Bonanza, and the walking distance up Ganvin Gulch, I stand corrected by Mr. Clarke, whose ten years' residence upon that small tributary of Bonanza entitles him to an intimate knowledge of that section.

I quite agree with Mr. Clarke's estimate of Mr. W. Ogilvie as "A Dominion land surveyor of astronomical attainments, a man of high accuracy and high integrity." But when he states that Mr. Ogilvie was "on the spot at the time as a surveyor" he is entirely in error. No one in the Yukon at the time was more pessimistic with regard to the richness of the Klondike than was Mr. Ogilvie. For many months he treated it as a huge joke, refusing time and again to visit the mines, and it was not until after the persistent solicitation of many of the miners to have their claims surveyed that he consented to comply with their requests. Early in the spring of 1897, fully eight months after the discovery, he made his first visit to the Klondike mines. Mr. Ogilvie kindly surveyed most of the claims on Bonanza and Eldorado, absolutely refusing to accept one cent of remuneration, and demanding only that each claim owner supply him with the necessary men to help run the lines.

It is quite evident that Mr. Clarke misunderstood my reference to panning in gravel as distinct from panning in bedrock. What I maintained was that the gravels above bedrock carried small values, and that in our prospect holes and drifts no rich pans were obtained except on top of or in bedrock. Rim rock is bedrock, and not gravel. The bit of rim where Carmack did his first panning was not rich, as many old-timers tried the same place a few days after the discovery, and it is evident that Carmack did not find much when he did not pan sufficient to pay his recording fee of $15. He may have brought down to Forty Mile $12.75 and have used a part of it for a few meals or drinks, but what he showed us was about two or three dollars in a small paper.

It might be of interest to give a few instances of how little value were the claims on the principal creeks in the Klondike during the year 1896. Johnson, who was partner of Andy Hunker, had previously staked in the forties below on Bonanza Creek. This claim he gave to Billy Caldwell for nothing. Caldwell, being "broke," gave me a half interest to pay a recording fee of $15. A couple of months later he had an offer of $600 for the whole claim, and we gladly sold it for that sum. At one time I might have exchanged my Claim 53 Below, on Bonanza, for two or three Eldorado claims. No. 31 Eldorado was staked by the "Baldfaced Kid," and sold to Tim Bell for $51. Bell sold it in 1897 for $31,000. Old Mr. Cook staked 16 Eldorado, probably the richest claim in the Yukon, and then traded with Lippy for No. 35 Eldorado, which turned out to be one of the poorest claims on the creek. Charlie Anderson thought he had been robbed when he was made drunk and when a claim on Eldorado was sold to him for $1,500. He came crying to the police barracks and wanted us to get his money back. He took out over a million from his drunken investment. George Carmack's claim was not considered of any more value than other claims in the vicinity. The Callson brothers, after sinking their first shaft on 27 Above Bonanza, would gladly have sold for a thousand dollars. Many more instances of unknown value could be given.

In conclusion I wish to say that Mr. Ogilvie was never a Canadian government official in the Yukon until he was made Commissioner to succeed Major Walsh about 1898. Further, that I have seen pans washed that contained over $1,000 before the Skookum or Chechako Hill was known, and have on my own claims washed $1,785 in five pans, so it is not likely that I would "be surprised at $700 being panned by three men in two days." But I say positively that no such amount was panned in August, 1896, by George Carmack and his Indians from his Discovery rim rock or any other part of their claims. Finally, I have no desire to belittle Carmack in his discovery or to boost Henderson. Personally, I believe that Frank Swanson, a Dane, who was with Henderson and was a real practical man of experience far greater than both discoverers possessed, should be entitled to considerable credit, because without Swanson I do not think Henderson would have found anything worth calling a discovery. A. E. WILLS.

The Pas, Manitoba, Canada.

Setting Diamonds in Drill Bits

THE EDITOR:

Sir—Mr. Young's article of March 31, and the comment by Mr. Channing of April 21, remind me of some "ancient" diamond-drill bits which were found in South Africa in old workings, and which probably date around 1884 to 1885. These were cutting 4-in. cores with from thirteen to seventeen stones in each. The stones were set in lead, which appears to have been poured while molten. I am told, however, that this process was unsatisfactory because of loosening of the stones when under pressure in drilling. Hence, though it sounds simple to set stones in molten lead, that method is not worthy of the consideration which should be given to Mr. Channing's suggestion. GILBERT HART.

Birmingham, Ala.

Heat Treating Drill Steel

THE EDITOR:

Sir—In your April 14 issue there is an article entitled "Rock Drill Steel," in which there are certain statements to which exception must be taken.

It will be granted that many users of rock drill steel have a superficial knowledge of the heat treatment of steel in general, but they have a wealth of experience in the heat treatment of rock drill steel. There is a limit to what one may learn from one's own experience, and we continually are drawing on the experience of others. So the mine smith or the mine superintendent no doubt desires information of value from whatever source he may feel safe in placing his confidence. But where is he going to place his confidence?

The article referred to above states that the temperature for forging drill steel "at no time should exceed 1,600 deg. F." That statement will not bother the very few who have means of measuring temperature accurately. To them it is a practical impossibility with the available forging equipment. To the great majority of users of drill steel 1,600 deg. F. means some color—to this smith bright red, to that one orange or lemon or what not. The man who measures temperature in his shop by a correct standard dismisses the article. The man who measures temperature by a mind-carried scale of color difference reads on; he cannot refute nor endorse the 1,600 deg. F. statement. But the next statement he can check will stop him. He is told that shanks should be quenched in oil and drawn at 600

deg. F. If he has never tried drawing an oil-quenched shank he will learn from his first experiment how useless if not absolutely detrimental the practice is. Then comes a statement that neither of these can check. Fortunately, the two statements above will probably have killed the confidence of the reader looking for information, and even if it hasn't the instruction may be moderately harmless. It says, "Good results are obtained if the steel is annealed before hardening. Heat the steel to 1,550 deg. F., cover with powdered lime, and allow it to cool slowly." The original bar was cooled in air after rolling, and now it is proposed to cool a part of it in lime (a slower cooling), causing a structural change (and probably for the worse), which later is partly to be altered to a water-quenched structure producing at least three different structural conditions. Moreover, here is one who recommends a forging temperature not exceeding 1,600 deg. F. and follows it by recommending an anneal at 1,550 deg. F. At what temperature does he expect a forging to be finished from an initial temperature of 1,600 deg. F.?

Fortunately, the practical man has experience to guide him, and in his delving for additional guiding may we hope that he will use experience to test the worth of his reading matter. Far better this than a wholesale condemnation of the written word.

Rolla, Mo. FRANCIS B. FOLEY.

Activity in Clear Creek County, Colorado

THE EDITOR:

Sir—In the news article on activity in Clear Creek County, Colo., which appeared in the *Journal-Press* of April 14, 1923, on p. 681, W. H. Staver states that the operations of the Wasatch-Colorado Mining Co. are unprofitable. What kind of man is this W. H. Staver? He is the same fellow who recently, through your columns, attempted to knock the management of the former Terry property in the San Juan. Why do you lend your valuable columns to such an unreliable correspondent? By doing so, you are doing a rank injustice. To show you how unreliable that article is: he states that the East Butte Mining Co.'s equipment includes tube mills, Ruth rod mill, Deister-Overstrom tables. This is untrue. They have none of them. Their equipment consists of crushers, rolls, Chilean mill, Hardinge ball mill, Janney, Akins and Peirce flotation machines, and Akins classifiers. No tables are operated.

Now, as to the Wasatch-Colorado Mining Co.'s operations: His article is a decided, unwarranted, and untruthful knock. The lead-zinc ore in this district is not hard to separate, and our operations are not unprofitable. We are not paying dividends, but one-half of our mine force is on development work and we are paying the entire expenses out of our operations.

Mr. Staver did not see me and did not inquire at our Chicago office before he wrote this knock, so had no authentic information. I have met the man but once in my life and that was casually several years ago. So why his desire to knock, and knock untruthfully?

As to our mill product: We produce a lead concentrate which contains from 22 to 40 oz. silver and 40 to 55 per cent lead, with less than 10 per cent zinc and less than 4 per cent silica. Also, a zinc concentrate averaging 42 per cent zinc, 7 oz. silver, less than 3 per cent lead and less than 4 per cent silica. Four-fifths of this concentrate is made on our jigs and ranges in size from 3 mesh to 10 mesh. The balance is made on tables. The jig-tailing loss is remarkably small. Our ore has an average concentration ratio of 5 to 1, and our jig tailing averages from a trace to 1 per cent of lead and from a trace to half an ounce of silver, and less than 2 per cent zinc. What real loss we have is in slimes from our tables, where only 20 per cent of our ore is handled, and we have made provision for flotation to handle these table slimes.

In addition to paying for development work out of production, we have also bought and paid for considerable machinery out of the production. We have one of the most up-to-date plants, both mining and milling, in Clear Creek County, and are, and for years have been, the largest shipper in the county.

Silver Plume, Colo. F. L. PALMQUIST.

Future of the Low-Grade Gold Mine

THE EDITOR:

Sir—C. Terry du Rell's contention, in the issue of April 21, that my article on the future of the low-grade gold mine contained the "worst sort of slander," is too absurd to justify further discussion. Details of his connection with the metallurgical work at the Yellow Aster nearly a quarter of a century ago are now published apparently for the first time, for he says, "Never before have I taken the trouble to reply to articles concerning the Yellow Aster," thus indicating his preference to remain silent on what must be considered as an important development in Western technology in the early days of the cyanide process. Such reticence cannot fail to lead to misunderstanding.

Mr. du Rell takes exception to my statement that, before publishing the article in which I recommended tentatively that consideration be paid to the merits of bulk leaching, I had come to the conclusion that such a method had not been considered by those in control of the technical work. As a matter of fact, in addition to obtaining an opinion on the subject from several engineers, I submitted the manuscript to the Yellow Aster company officials for confirmation as to historical data, particular care being taken in the covering letter to draw attention to the final remarks in regard to bulk leaching. It was returned unaltered, accompanied by a statement that confirmed my conclusions and showed that at least one of the officials who has been connected with the company since its inception had no knowledge of or had forgotten about the tests that Mr. du Rell now explains were done in 1900.

No real progress in technology is possible without an interchange of views and experiences. Mr. du Rell's correction proves my contention that it is unwise to make suggestions without an intimate knowledge of details; but I would add that temerity on the part of someone is needed to stimulate discussion and to pry loose those facts that so many engineers will not take the trouble to disclose.

In regard to bulk leaching, it is pertinent to add that improvements in milling and ore-handling equipment, in refinements to insure the success of large-scale operations, and in discoveries in chemistry and metallurgy have revolutionized the process. If the opinions that were current twenty-five years ago as to the economic impracticability of the bulk leaching of low-grade ore had remained unchallenged, Chuquicamata today would be a mountain of discolored stone, instead of the greatest copper mine in the world. A. W. ALLEN.

San Francisco, Calif.

Culture and the Engineer

By T. A. Rickard

ON APRIL 7 the engineers of Colorado, under the auspices of the Colorado Scientific Society, formally opened a new technical library at Denver. The establishment of this library is interesting because it is financed by the fees collected under the Licensing Act. Other states have enacted similar legislation, and it is fair to say that mining engineers generally have opposed the licensing because it hindered their professional work, which is not of a localized character, and because it subjected them to the inquisition of petty officials. Apparently the engineers of Colorado have performed the miracle of a Luther Burbank by changing a prickly growth of legislation, a veritable cactus of legal enactment, into a spineless product, the fair flower of useful endeavor. In three years the sum of $15,000 has been paid to the State Board of Engineers under the terms of the act; this sum, together with similar fees to be collected in future, will constitute a fund for the buying of books to be added to the library of the Colorado Scientific Society.

The starting of this library provokes inquiry as to the need for culture among engineers, particularly those of our own branch of the profession. I submit that whereas technical libraries are valuable to us, we need the broader culture not to be obtained from technical books. It is a fact to be regretted that, although our material civilization is largely the work of the scientist and the engineer, yet the government of the world today remains in the hands of diplomats, lawyers, and financiers. H. G. Wells, in his anticipation of the reaction of mechanical and scientific progress upon human life and thought, repeatedly dwells on the idea that the engineering type of man will establish his leadership in the civilized community, and deplores the fact that he is "quite disproportionately absent from political life."

Much has been said and written about the duty and opportunity of the engineer in public affairs, but it must be confessed that the engineers, especially mining engineers, that have taken an important part in national and international affairs have been so few in number as to emphasize the exceptional character of their achievement, and even of many of them it can be said that they would have been more useful and more effective if they had possessed more culture—that is, more of the mental equipment required for the larger work of the world—for, when all is said and done, the proper study of mankind is man. Human nature is still the prime factor in human affairs, and a mere knowledge of physical facts will not suffice to give a man the sympathetic understanding—the prophetic insight—needed for the wise government of society in its larger sense. We engineers must confess that, despite its share of fakers and shysters, the legal profession has a higher status than the engineering; so has the medical profession; so has the ministerial or theological —because lawyers, doctors, and clergymen as a rule are better educated, in the sense of having a wider culture. The engineer is too much of a specialist. That specialism may be essential to a mastery of his technique and the earning of a salary, but it is a stumbling-block to effective citizenship, which calls for a knowledge of history, an appreciation of current thought, an acquaintance with the springs of human action, and a warm contact with the heart of humanity.

In our democracy we give precedence to no class or profession; we take men as we find them; nevertheless it is noteworthy that the graduate of West Point or Annapolis is usually a more cultured man than the graduate of a School of Mines, and for that reason, apart from his uniform, he enjoys a higher social status than the mining engineer. The graduate from a law school likewise is better read and better grounded in the humanities than our brothers of the pick and gad. The followers of Æsculapius undergo a severe training, and their profession calls for a knowledge of the physical structure of their patients and an insight into the operations of their minds, so that the physician also has a more comprehending touch with human nature and its manifestations in public life than the engineer can claim.

The obvious first answer to this line of argument is that the mining engineer has neither the time to acquire the aptitudes nor the need to use the knowledge to which the so-called learned professions pay so much respect. Indeed, the time was—and still lingers—when an obviously well-educated mining engineer was assumed to be not "practical," and when a certain roughness of manners and crudity of speech was supposed to betoken a familiarity with the work of the mine and mill. That inference might serve for the appraisal of a foreman or a shift boss, but it is illogical, and therefore foolish, if applied to estimating the usefulness of those who direct the larger operations of mining and aspire not only to be engineers but also to take their part in civic and national affairs. The notion that refinement connotes effeminacy or that culture is unsympathetic to the democratic idea are pathetic fallacies, of which we had better rid ourselves, whether as engineers or as Americans. Moreover, the purposes of intelligent living are not fulfilled by success as a practitioner nor even by eminence as a public man; there remains the winning of happiness for oneself and the contributing of happiness to others, beginning with those that are nearest, in the home and among friends.

Culture, such as comes from conversation and books, from history and philosophy, from poetry and prose, conduces to the refinement of mind and the development of those faculties which make a human being capable of enjoying and maintaining the amenities that, more than metal and stone, or mines and railroads, express civilization in its ultimate phase. To take a concrete example: the reading of such books as Wells' "Outline of History" or of Page's "Life and Letters" is essentially civilizing; the first gives a perspective of history that is enriching to the mind and contributory to an understanding of mankind; the second illuminates more recent events and gives us an acquaintance with a great American, whom it is a privilege to know even by the mental process of reading his personal letters. Such books are cultural because they tend to cultivate philosophic thinking, a sympathy with humankind in its groping toward light, and an intelligent understanding of human affairs—upon which hinges the effective discharge of our duties as engineers, as citizens, and as men in this flux of phenomena called life.

Geology of the Homestake Orebodies and the Lead Area of South Dakota—II

General Structure Studied and Determined—Orebodies Occur in Pre-Cambrian Metamorphosed Rocks—Deposit Rich Mineralogically—Age of the Gold

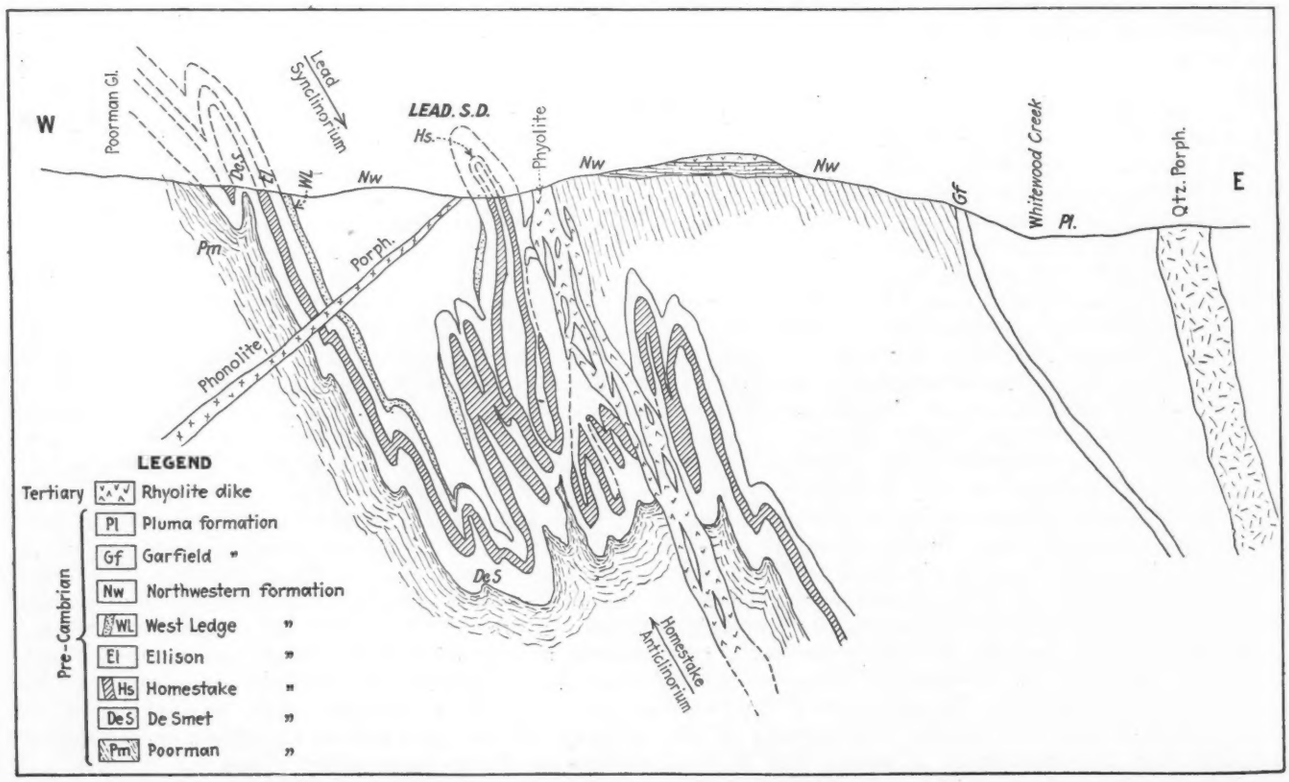
By J. O. Hosted and L. B. Wright
Geologists, Homestake Mining Co., Lead, S. D.

THE FIRST DETAILED WORK on the structure of the pre-Cambrian in the Lead area of South Dakota was done by Sidney Paige several years ago. He traced certain prominent beds from the hilltops just west of Deadwood in a southwesterly direction to Kirk, where they seemingly butt into a series of beds having a southeast trend and extending northwest from Kirk over the South Lead Hill and across the city to the hills west of the Homestake open cut and thence to Deadwood Gulch. He assumed from the thickness of the northeast-striking beds, which were apparently cut off against the series of northwest-striking beds, that there must be a fault of considerable proportions along a plane dipping steeply to the east and extending from just south of Kirk in a northwesterly direction approximately along Bleeker St. and along the west wall of the main open cut.

From these data Mr. Paige deduced that the Homestake orebody was a replacement deposit in a calcareous series which had a trend from the northeast into this zone along the fault plane. He also recognized the folding which plays such an important part in the structure. In the summer of 1920 he spent six weeks with the writers of this paper in and around the mine, paying special attention to the drifts and crosscuts that would intersect the fault plane. From data gathered at that time (and since by us), we were unable to prove the presence of a fault of the originally supposed magnitude; however, as our maps indicate, the west limb of the syncline which forms the western part of the main orebody has been sheared along the strike until in some places it is entirely lacking. Recently Mr. Paige again visited the mine to check up his data and collect specimens of ore and rhyolite, preparatory to a study of the age of mineralization. At the time of this later visit we were in essential agreement as to the main structural features.

The Forces Causing Folding

On the surface, beds have been traced around the crest of a southward plunging anticline near Kirk, from the eastern series continuously throughout the same series on the west side of the open cut, interrupted in their continuity only by drag folds on the major anticlinal structure. A glance at the sketch map of the surface geology (see Part I) will show the structure accounting for the change in strike from the northeast, east of the open cut, to northwest, west of the open cut.

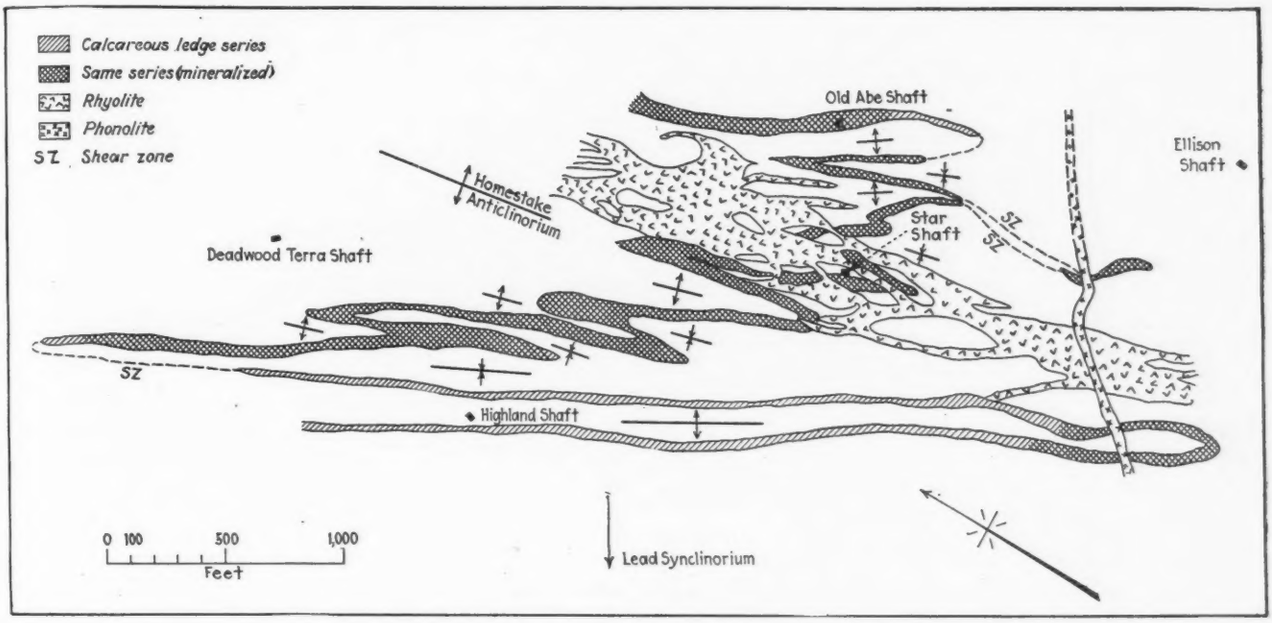


East-west section near Lead, showing geologic structure of folded pre-Cambrian strata; also Cambrian sediments and porphyries

It will readily be seen that, in such an intensely folded structure, hard beds will be broken and the softer ones pulled and squeezed to alternate thickness and thinness, with shearing at many points throughout the structure. Had the forces which caused the folding been greater, no doubt a fault such as suggested would have been the result. From surface observation only it would be impossible to work out this system of complex folds, but the mapping of nineteen mine levels gives indisputable evidence of the structure, as each consecutive level was mapped without reference to those previously studied, and vertical sections at 1,000-ft. intervals across the general strike show a series of folds through which those strata which lie at greater stratigraphic distances from the Homestake formation.

The anticlinorium as a whole is overturned, both limbs dipping to the east at about 70 deg. Western dips are found only in the case of the western limbs of the minor folds, and this holds true only at points where they have not been tightly folded and overturned. The minor folds of the Homestake system have varying angles of plunge, but in many instances the anticlinal crests or noses plunge more steeply than the synclinal troughs.

A dike of rhyolite (Eocene) striking N. 15 deg. W., irregular in width and encompassing numerous lenses



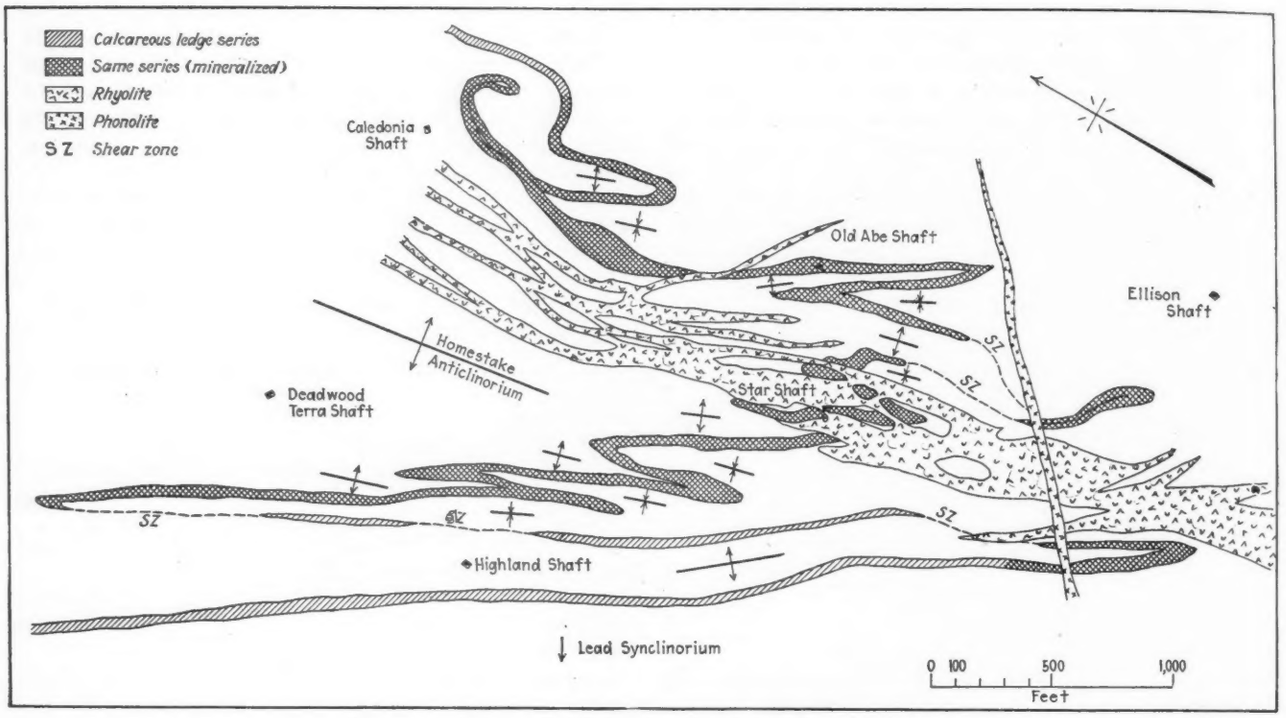
Geology of part of the 200 level of the Homestake mine

the Homestake formation can be traced for considerable distance east and west of the main orebody. The development of the general structure was aided greatly by a system of long crosscuts extending in both directions from the main workings on several levels. These crosscuts expose rock that is under cover of the Cambrian formation on the surface.

Regarded as a whole, the Homestake folds are a series of anticlines and synclines on the crest of a major anticlinorium whose axis dips to the southeast at an angle of 45 deg. The anticlinorium, as outlined by the outcrop of the Homestake formation, measures 6,000 ft. across the widest part, the measurement being taken normal to the axial plane from the crop of the trough of the Lead synclinorium at the head of Sawpit Gulch, to the east limb of the anticlinorium or Homestake formation, where it crosses Deadwood Gulch 1,200 ft. east of Blacktail. The east and west limbs "converge," the east passing through the Homestake folds and to the Independence anticline (just west of the open cut), which is the southernmost crop of the anticlinorium on the surface. From underground workings the outcrop of the nose of the Independence anticline is computed to be at the junction of Cold and Addie streets, where a limited exposure verifies the calculation.

The formations up to the Garfield, and down (stratigraphically) to the Poorman, take part in the major folding system; but the folding is less prominent in of the pre-Cambrian rocks, cuts through the Homestake folds at the crest of the anticlinorium. This dike, as shown in the vertical section of the mine, has followed up the bedding or schistosity and broken through the folds, finally reaching into the Cambrian formation, where it is represented by sills. It also forms the crests of some of the higher ridges; and judging from its occurrence two miles north of Lead, it must have been extruded upon the surface of the partly eroded Cambrian formation. Other dikes, varying in thickness from a few inches to two hundred and three hundred feet, of rhyolite and rhyolite porphyries of the same age, occur in all directions from Lead. Some are of coarse texture, grading toward the basic. The strike of the dikes generally parallels the strike of the inclosing schists. In following any one of them from an outcrop in a ravine it is found to form low, evenly rounded ridges which reach up to the higher elevations to the larger masses that form the sills and cappings. The outcrops are prominent, owing to the light yellow or buff color of the weathered rock. Brecciation is common, but not always found along the contacts. In many instances the breccias contain pyrite, but they seldom have an appreciable gold value.

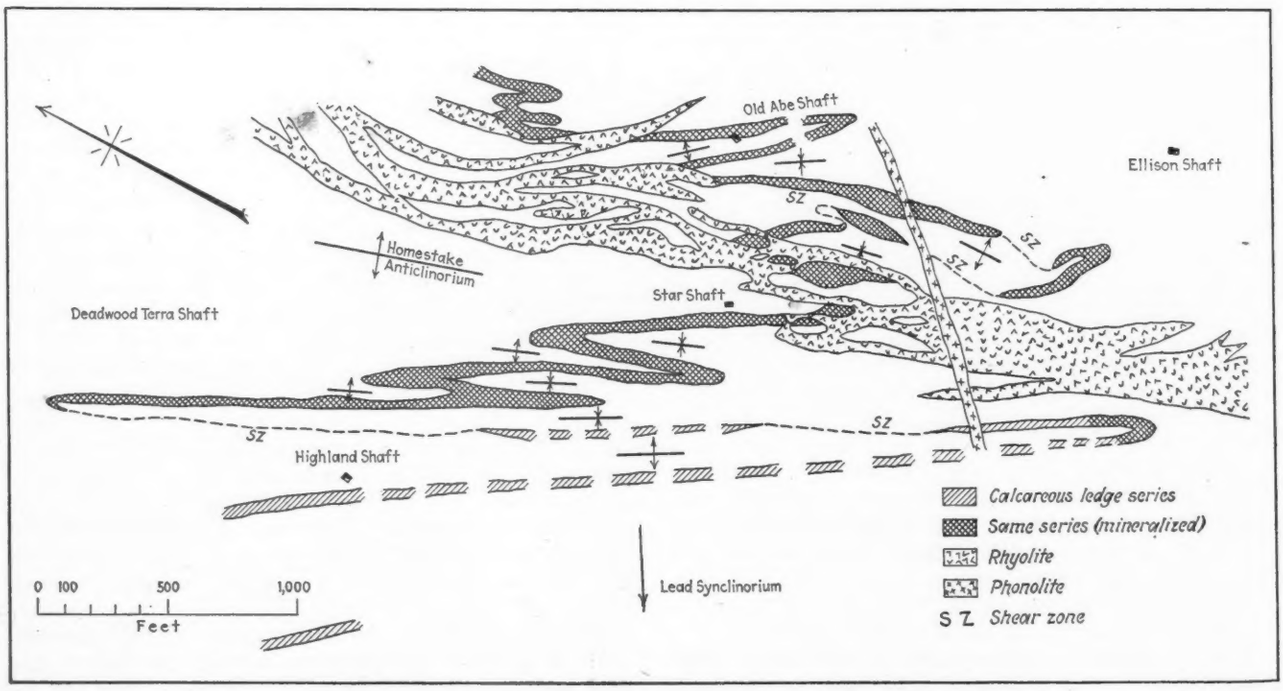
On either side of the dike cutting the Homestake folds is a series of fractures, roughly parallel to the dike and containing from a few inches to two feet of gouge. These fractures extend from the surface to the



Geology of part of 300 level of the Homestake mine

lowest levels on both sides of the orebody, and the rock within their boundaries has undoubtedly been uplifted by the force of the intrusion. As near as could be determined, the differential movement along these zones was not more than twenty feet, as the various beds intersected are traceable across the planes of movement without material displacement. The distance of the fractures from the dike is about the same on either side, or 500 ft. They have a dip of 70 to 80 deg. eastward and strike 12 to 25 deg. northwest. It is possible that they served as verticals or channels for the solutions accompanying and following the intrusion.

The general occurrence of the Cambrian formation can best be presented by calling attention to the maps and sections. It is generally found at the higher elevations, rarely having a dip of more than 10 deg. except where considerably disturbed by the porphyries. The vertical pre-Cambrian rocks butt up against the flatlying Cambrian conglomerate, which is made up of quartz pebbles, fragments of slate, schist, and quartzite,



Geology of part of 400 level of the Homestake mine

with a ferruginous-calcareous cementing material, probably derived in part from the beds above (dolomite). The calcareous nature of this cementing material is believed to have made possible the mineralization of the "cement workings." We do not believe that they were placer deposits of pre-Cambrian gold, but have concluded that they were mineralized in the same manner and at the same time as the Homestake ledges and the deposits in the Cambrian dolomites. Our reason for this conclusion will be set forth in the discussion of the "Age of the Gold."

Occurrence of Orebodies in Pre-Cambrian Metamorphosed Dolomite

The Homestake formation, composed of a magnesian limestone, and also the West Ledge formation, of similar rock but originally more siliceous, are the strata which contain the orebodies. They are intensely folded and compressed, until, as in the case of the main orebody, the thickness has been increased several times, due to the repetition of beds. These strata have been metamorphosed until now they are for the most part represented by cummingtonite and chlorite. There are many phases of this alteration, grading from a pure magnesian limestone to hard massive beds of cummingtonite. Specimens are common in which "secondary" cummingtonite has been formed across the schistosity that was developed during the second period of folding. This seems to indicate that the recrystallization and alteration was somewhat of a continuous process while the rocks were deep-seated. That these beds were well within the zone of flowage during both folding periods is well evidenced by the continuity of the harder beds throughout the folds. This is one of the reasons why we are inclined to the belief that the rocks are older than Algonkian, as, to have been so deeply in the zone of flowage during the second period of folding, they must have been covered by a great thickness of younger rocks (Algonkian) which were eroded before Cambrian time. It has been stated that the quartzites fractured rather than folded, but this should not give the impression that they did not fold to a considerable extent before fracturing. They have been traced in an even fold around the crests of anticlines in the mine, curved but in places disconnected.

It is noticeable that where folding is more intense the beds are more chloritic and talcy. Also that along the straight limbs of folds the mineralization is poorer. The best ore is found in the noses of the folds, and where free gold is found it is usually in the chlorite or talc rather than in the cummingtonite, or whenever it is found in the quartz it is in the fractures. By far the largest proportion of gold is related to the arsenopyrite. It also occurs in pyrrhotite. Pyrite seems not to be related closely to the gold. The relation of the three principal sulphides will be discussed under the "Age of the Gold."

There are many varieties of cummingtonite, due perhaps to the varying proportions of iron. It is all of the radiating variety except where the iron content decreases and it grades toward asbestos, which occurs only locally.

A table of minerals and their occurrence has been prepared (under mineralogy) which discloses a relationship between the metallics associated with the rhyolite and their occurrence in the ledges. Metamorphic minerals, of course, are common, in some cases to all of the groups of rocks. In the case of pyrite, pyrrhotite, gold, and quartz, though they are found in most of the rocks, their importance in the slates, schists, and quartzites is almost negligible.

The sections of the mine show the structural relations of the rhyolite to the Homestake series. From a study of the contacts it is evident that the dikes contributed little toward the alteration of the adjacent rocks. The most noticeable effect is the addition of silica, thereby converting some of the schists into hard quartzose rocks.

At the contacts where the rhyolite has cut the cummingtonite series, there is nearly always a sharp contact, with apparently little metamorphism. In some regions quite distant from the dikes, the magnesian limestones are more highly altered than at some places near the dikes, and these more highly altered places are richer in gold than some less altered but nearer the dikes. This indicates that the state of alteration just before the intrusion was an important factor in ore-making within the zone of mineralization, and a selective replacement was the result, probably due to the greater permeability of crushed strata at the crests of the folds. However, viewed as a whole, the zone of mineralization is limited to an average width of 700 ft. on either side of the dikes.

The Homestake series at greater distances is unproductive, showing that both the extent of previous crushing of the magnesian limestone at the time of intrusion and the proximity of the rhyolite are requisite for commercially mineralized rock. Many areas occur in which only one of these conditions exist, but they are unproductive, owing to the lack of the necessary combination of both. This is one of the valuable points which our geological study has brought to light, and should serve to eliminate prospecting in unfavorable areas, thereby effecting considerable saving.

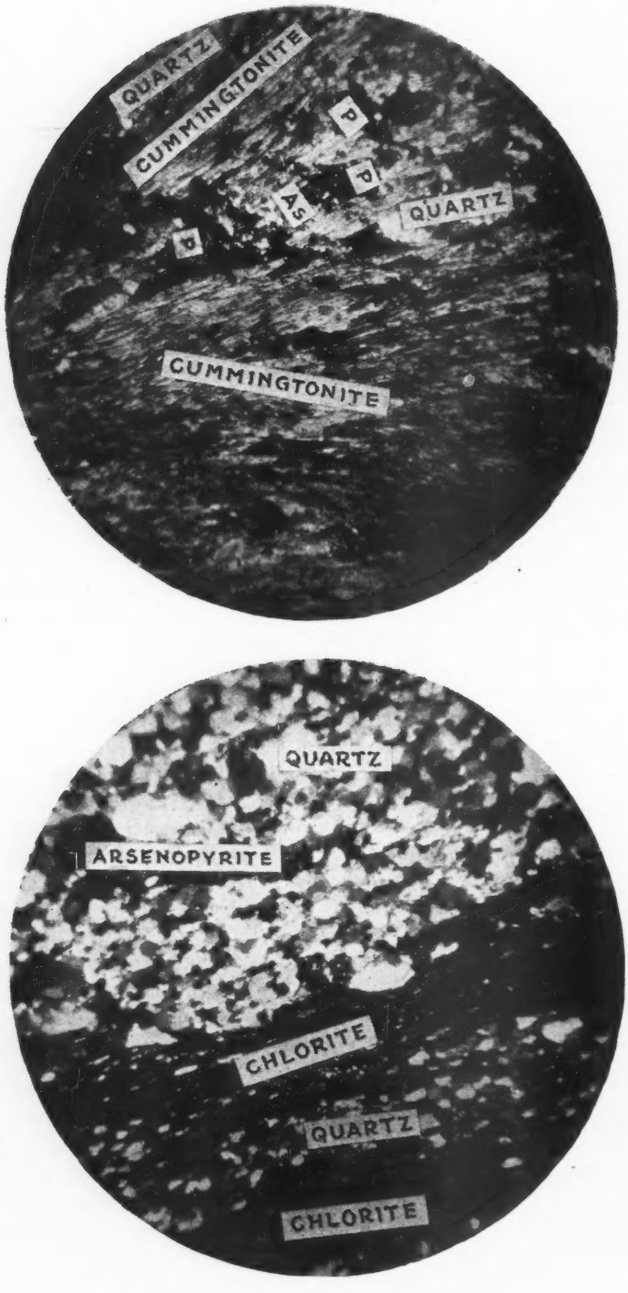
Garnet schists, slates, and quartzites, where intruded by the rhyolite, are usually brecciated along the contacts, but there is no mineralization except pyrite, with no appreciable amount of gold. A number of fractured zones are quite pyritiferous, and from the nature of the sulphides it would appear that these zones or courses served as channels or "verticals" for the mineralizing solutions, which did not precipitate their gold until encountering sufficiently permeable dolomitic limestone in the pre-Cambrian formation, or when not encountering these conditions, reached the Cambrian formation and there effected a replacement.

It has been the belief of some geologists that the gold is associated with the pre-Cambrian granite of the southern hills, but considering the fifty or sixty miles separating the Homestake from the influence of this igneous mass, and in view of the direct relationships as expressed above, of the Eocene rhyolite and the ledge formations, we are at a loss for evidence in support of the pre-Cambrian theory of the age of the Homestake gold. Furthermore, the stringers of pre-Cambrian quartz, which may be associated with the southern hills intrusions, are not gold-bearing in this region.

Conditions Surrounding the Deposition of the Gold

It has been pointed out by several authorities, especially by Dr. W. H. Emmons, that manganic oxides play an important part in the precipitation from solution of gold. It has also been observed that, in the presence of calcite, gold will not precipitate from a solution with chlorine as a solvent, as the chlorine cannot be liberated. This may explain the low value of the purer limestone

beds. If so, it follows that there is an element favorable to the precipitation of gold in the chlorite and talc masses, as opposed to the chloritic schists and slates in the mineralized zone, which are practically barren. The explanation offered in regard to this is that in the altered magnesian limestone beds there is a small amount



Appearance of rocks under microscope

of magnesite, which V. Lenher has shown to be an effective precipitant of gold, whereas in the purely chloritic schists and slates, the silicates and lack of the proper carbonates are not conducive to the chemical action necessary.

Oxides of manganese are common in the rhyolite intrusives and have been found as dendrites and in masses filling fractures. These masses have also an appreciable amount of tungsten, which may have some bearing on the deposits of that mineral in the Cambrian formation west of the open cut.

It is now evident that the rhyolite intrusion gave rise to the mineralizing solutions and also that the manganic oxides served in aiding the precipitation when the whole combination reached a locality of sufficiently low temperature and pressure to preclude the further remaining in solution of the gold. The question now arises as to what depth below the present surface this precipitation began.

The geological relations indicate that at the time of the intrusion of rhyolite, the surface of the pre-Cambrian rocks was almost identical with its present configuration; also that the overlying Paleozoic sediments were limited to a thickness that would not greatly influence the temperature at depths in the pre-Cambrian rocks. The fact that the rhyolite is unusually fine grained on the lower levels (and about 200 ft. in total thickness) shows that the temperature at that depth was not much more than would result from the heat of the dikes plus the normal pre-intrusion temperature. It follows, then, that the lower limit of the zone of gold deposition is far below the present level (lower or 2,000-ft. level), provided, of course, that the solutions encountered permeable magnesian limestones.

Many Minerals Found in Deposit

As most of our attention has been directed toward structure, our data on mineralogy is necessarily somewhat general. However, we will include our observations to date. The following tabulation will probably best serve as a means of presenting the chief minerals occurring in the typical rocks of this district. This does not include the Cambrian formation, although most of its minerals are to be found in the pre-Cambrian rocks.

The table includes all the minerals that have been observed in the mine. Some of those whose occurrence is rare have been included, although it might not be an easy matter to find a recurrence, especially in the case of galena, wolframite, copper, fluorite, chalcopyrite, proustite, and tourmaline. These minerals were observed in and near the rhyolite dikes. The occurrence of galena has been mentioned previously in the report. The copper was found in the rhyolite on the 2,000 level, and was a lone occurrence. Proustite was observed in the main orebody at about the 300 level. Fluorite, chalcopyrite, and tourmaline have been found in small amounts on the various levels in or near the rhyolite dikes.

Kaolin occurs abundantly on the upper levels in the zone of oxidation.

Hematite and limonite are found in the zone of oxidation in all of the formations, but chiefly in the femic rocks. On the lower levels these minerals are found in water-courses and fractures.

Arsenopyrite is the chief sulphide found in the ore or ledge series, with pyrrhotite second. Differential sampling has shown the gold to be associated with the arsenopyrite to a greater extent than with the pyrrhotite.

Pyrrhotite is most abundant in the ledge series, but also occurs to a considerable extent in the barren schists and slates. It is always finely crystalline, and in the schists and slates occurs in thin veinlets along the planes of schistosity.

Pyrite is not so common as the other sulphides and is apparently quite uniformly distributed throughout

most of the series, rarely occurring, however, in the quartzites and basic intrusives.

Gold, of course, is most abundant in the ledge series, which contain on an average about ⅓ oz. per ton. The rhyolite has an average of 1/100 oz. and the slates and schists from 1/40 to 1/200 oz. per ton. Its distribution in the orebodies is irregular. Two typical sample lines, 120 ft. apart, across the main orebody on the 1,000 level, give the following values in dollars per ton. The samples each represent 10 ft. across the strike.

Homestake Sample Values—Hanging Wall to Footwall

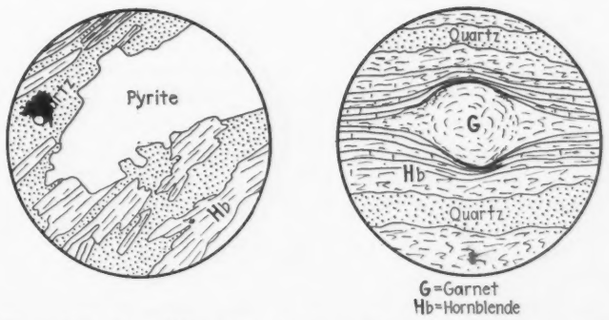
First Sample Line	Second Sample Line	First Sample Line	Second Sample Line
$11.70	$3.10	$4.70	$2.25
25.20	8.45	4.40	6.80
.80	14.45	3.10	15.50
6.30	16.50	7.50	20.85
1.80	9.70	8.00	1.45
6.40	12.40	6.00	1.85
17.20	36.35	19.30	6.20
8.40	38.25	12.50	9.30
14.50	37.00	7.50	8.25
17.10	17.75	7.20	.40
30.00	.80	.40	.20
14.80	8.25	.30	.20
13.20	.20	.10	.20
18.60	1.00	.10	.20
4.80	.40		
8.30	.80	Average 9.71	9.04
20.90	1.20		

These averages are over twice as high as the mill run of ore, but serve to illustrate the character of gold distribution. It is sometimes found in the free state in the chlorite and serpentine, but is most commonly intimately associated with arsenopyrite and pyrrhotite.

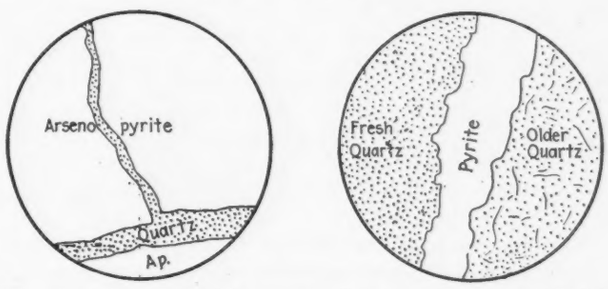
Quartz is found plentifully in all of the formations except the amphibolite dikes. It constitutes the greater part of the rhyolite groundmass. In the slates and schists it is found as an accessory mineral (excepting the quartz-mica schists), and in stringers and lenses from a fraction of an inch to several feet in width. In the ledges it occurs both in stringers (folded) and irregular masses of post-folding age, undoubtedly Tertiary. None of these varieties are gold-bearing, except in the ledges, where occasionally gold is found in the fractures, associated with one of the sulphides.

Hornblende is found in short prismatic crystals in the ledge, the basic intrusives, the slates and schists, and rarely in the quartzites. It occurs in the ledge as a phase of the cummingtonite development. Cummingtonite is found in the ledge series only. Its color is gray-green to dark green. The crystals radiate from a common center, and intergrowth is noticeable in the larger masses, resulting in a rock that is difficult to break and mine. Its proportion in the ledge rock is variable, grading from a small amount in the calcareous phase to nearly 100 per cent cummingtonite in the magnesia-iron-silica phase. Tremolite is found in minor quantities as a phase of the cummingtonite development. The crystals have a parallel arrangement as in asbestos and are lighter in color than the cummingtonite.

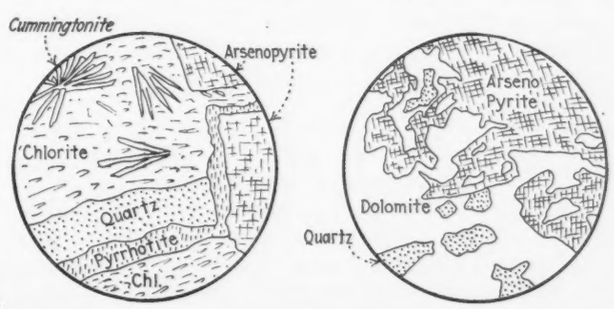
Tertiary quartz cutting pre-Cambrian slates, 900 level, West Ledge



Showing the difference in occurrence between a pre-folding mineral (garnet) and a post-folding crystal of pyrite (Tertiary)



Showing quartz filling fracture in arsenopyrite (left) and pyrite associated with late quartz, in relation to older quartz. The inference is that the arsenopyrite preceded the quartz and pyrite (and pyrrhotite?)



Showing pyrrhotite later than arsenopyrite (left); and arsenopyrite and quartz replacing dolomite (right)

Sketches of Rock Sections under the Microscope

Chlorite is most important in the ledge series, as the best values are found in the masses of this mineral which seems to be a product of the alteration of cummingtonite at the crests of the folds.

Serpentine is the extreme phase of the alteration, and free gold nearly always occurs in it where it (serpentine) has apparently been formed by the shearing of the chlorite adjacent to quartz stringers.

Garnet is most important in the garnet schists. In the ledge series deep red masses of garnet are found. The crystals in this series are not perfect, but they seem to be later than those in the garnet schists.

Large, well-formed crystals are found along the contacts of the basic dikes.

Dolomite and calcite occur mainly in the ledge series, and more abundantly in the unaltered portions as essential minerals. Calcite is found in stringers and veins filling fractures, where it has been leached from the calcareous ledge series and redeposited at lower levels.

Graphite is plentiful in the slates and darker schists. It seems to have been formed by metamorphism of the carbonaceous material in these sediments. Frequently it is found near the contacts of dikes. It is also found in places where folding and shearing have been intense, producing graphitic schists in which the original bedding is completely destroyed.

Psilomelane and pyrolusite occur in a fracture in the rhyolite on the 1,250 level. Pyrolusite occurs on the joint faces of the rhyolite in dendritic form. Analysis of the manganiferous minerals shows the presence of tungsten. This is significant in view of the deposits of that mineral in the overlying "flat" formation.

Ankerite and siderite are usually found together in partly altered portions of the ledge series. It is noticeable that where these minerals occur in the ledge series the gold values are usually low.

Mica is the chief mineral in the mica schists. It is in the form of muscovite and sericite and is an accessory mineral in the ledge rock, basic intrusives, and quartzites. It occurs as an alteration product in the basic intrusives and phonolite. In the quartzites it is also found in the form of biotite.

Sericite is common in the schists, and no doubt some could be correctly classed as sericitic or hydromica schists. It is also found to a lesser extent in the phyllites and slates and rarely in the rhyolite and ledge series.

Orthoclase is found in the rhyolite, quartz porphyries, and phonolite. It is difficult to distinguish in the rhyolite, on account of the felsitic texture.

Plagioclase is found in large partially decomposed crystals in the basic intrusives or amphibolites; also as an essential mineral in the quartz diorites. Owing to the extensive weathering of the amphibolite outcrops, the crystals are rarely distinguishable except in thin section.

Augite and aegirite are easily recognizable in the phonolite, as it is coarsely crystalline. Augite also occurs in the amphibolites in large weathered crystals.

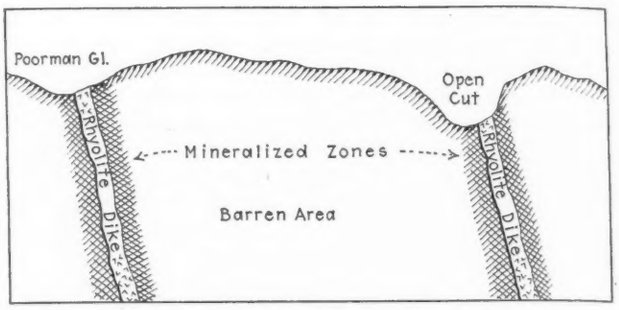
Nepheline has been found only in the phonolite porphyry in large well-developed crystals.

Zircon occurs in minute crystals in the rhyolite.

Magnetite constitutes a minor part of the basic intrusives, slates, phyllites, and quartzites. It is most abundant in the slates.

Age of the Gold

In nearly all that has been written concerning the age of mineralization at the Homestake, the tendency has been toward the belief of the introduction of gold during pre-Cambrian time. The late J. D. Irving, who perhaps has contributed most freely on the subject, believed that a combination of pre-Cambrian and Tertiary mineralization effected the great orebodies. All freely admit that the Tertiary intrusives are responsible for the mineralization in the Cambrian formation. If the Homestake ore is not of Tertiary age, then it is an exception to all other gold deposits in the northern hills. However, the gold deposits of the central and southern hills are undoubtedly of pre-Cambrian age.



Mineralization and the rhyolite dikes

As has been intimated in the section on general geological features (historical), it is our belief that the Tertiary dikes in the Homestake mine are responsible for most if not all of the mineralization. The chief reason for the belief of pre-Cambrian mineralization held by others is the occurrence of free gold in the Cambrian basal conglomerate. They deduced that this gold must have been concentrated during the disintegration of pre-Cambrian strata.

So far as we can learn, the type of gold found in the conglomerate is such as would be deposited by replacement rather than by mechanical means. It is very fine, and when found in larger pieces is needle-like, and not flat and stream-worn. Another example of this type of replacement deposit in conglomerate is at Liberty, in Washington, where the gold occurs both as placer and replacement. In this conglomerate the replacement gold is in threads and needles, and it is evident that it is later than the conglomerate. The placer gold is in flat smooth nuggets and grains, and is readily distinguishable from that of later age.

In the Cambrian formation around Lead, no mineralization has been found beyond those areas which are of distinctly Tertiary mineralization. The same relation holds in the pre-Cambrian rocks of the mine. The mineralization is confined to a zone which has the dikes through its center. The argument has been advanced that the dikes followed a plane of weakness along which the solutions had previously ascended in pre-Cambrian time.

There are two answers to this: first, that the dikes came through with such force that they seemingly disregarded the actual planes of weakness. Notice on the mine geology maps that they broke indiscriminately through the tightly folded strata when paths of easier access were available to the west along the straight limbs of the folds. Second, that there is another rhyolite dike about 2,000 ft. west of the main dike, and the dolomitic pre-Cambrian beds are also mineralized along a zone parallel to this second dike, with the dike along the center of the zone.

There are other prospects in the district in the pre-Cambrian rocks in which the values are near the contacts of the Tertiary dikes.

The two main series of dikes mentioned above have between them a barren zone in which the dolomitic ledge series occurs in all of its phases. These areas between the zones have been prospected, with only an occasional assay of more than a trace to 20c. in gold per ton.

The accompanying vertical section is a sketch illustrating the occurrence of mineralization in connection with the rhyolite dikes.

We are not prepared to assert that there was no pre-

Cambrian mineralization, but if there were an appreciable amount it seems reasonable that values could be expected without the Tertiary zones. There is a possibility that portions of some of the sulphides (pyrrhotite and pyrite) are of pre-Cambrian age. As has been recorded, they sometimes occur in thin films, as though they might have been planed out along the schistosity. On the other hand, in a siliceous schist or phyllite nothing more than a thin film could be expected along such fine structural planes. Certain of the chloritic schists outside of the ledge series contain well-formed crystals of pyrite which are of post-folding age. In the zones of mineralization the arsenopyrite is evidently a recent sulphide, and for the most part the crystals are well formed and have been undisturbed except near the phonolite porphyry dike, which is of post-mineral age. One instance is noted where a crystal of arsenopyrite is fractured and the interstice filled with quartz which is probably contemporaneous but later in crystallization. The growth of some of the crystals has been restricted in many cases, and they are often seen to conform roughly to the schistosity, but the microscope shows that there has been no movement along the boundaries of the crystals, which would not be the case if they were of pre-rhyolite age.

The pyrrhotite is also common in the mineralized zones; but, as has been stated, differential sampling has shown the gold to be more intimately associated with the arsenopyrite.

Though we have not made a special study of the sulphides with reference to their order of crystallization, from our observations the following order fits the usual occurrences.

1. Arsenopyrite.
2. Pyrrhotite and Pyrite (contemporaneously).

Some Analyses, by W. J. Sharwood

	Rhyolite 2000 Level	Phonolite 1000 Level	Ore—Mine Run	Cummingtonite	Micaschist	Quartzite
Silica	69.15	55.9	54.0	50.4	66.08	83.7
Alumina	14.4	19.2	7.7	1.8	16.22	3.1
Ferric oxide	0.65	3.5	17.7	.....	.....	.....
Ferrous oxide	.....	.....	.....	34.6	5.55	1.0
Manganese oxide	Tr.	.....	.....	0.6	0.04	.....
Magnesia	0.6	1.4	4.1	9.8	1.88	2.1
Lime	2.24	2.6	2.0	Tr.	0.36	3.2
Soda	2.4	4.3	0.5	0.8	1.30	.....
Potash	6.24	6.2	1.2	Tr.	5.30	.....
Water 105 deg. C.	0.4	4.0	.....	0.0	.....	5.2
Ignition	2.64	1.5	.....	.....	2.90	.....
Pyrite	2.3	Tr.	.....	.....	Tr.	0.2
Sulphides	.....	.....	4.8	.....	.....	.....
Water and carbonic acid	.....	.....	8.0	.....	.....	.....
Specific gravity	2.5	2.57	3.0	3.28	2.77	2.68

	Native Gold From Ledge	Average Gold Recovered
Gold	82.3 to 84.95	81.2
Silver	15.05 to 17.7	18.8
Other elements	Traces	Trace

Chrome Industry Increasingly Important

Chromium is now recognized as a practically indispensable metal in our industrial life, says *The Iron Age*. It enters not only into the manufacture of alloy steel and special alloys, but is also the basis of an important part of the refractory industry. New applications are frequently appearing, one of the latest being its incorporation in chrome-nickel steel castings for frogs and switches for railroads.

A statistical measure of the growing uses of chromium is given in a total of 65,435 tons of imports and domestic sales of chrome ore in 1913, whereas in 1920 the total was 152,777 tons. Even in the acute depression of 1921 the imports and domestic sales were 82,118 tons, or an increase over 1913 of about 25 per cent. It is estimated that 40 per cent of the consumption of chrome ore in 1922 went into the manufacture of the ferro-alloy, 35 per cent into refractories, and 25 per cent into chemicals, with the consumption for the year put at about 110,000 tons. The expansion promises to continue. New uses are being developed, particularly for chrome alloys, and in some industries the resulting changes may be revolutionary.

On the Abilities and Ethics of Seventeenth-Century Metallurgists

In "El Arte de Los Metales," written by Barba in 1637 and recently published by Wiley in a translation by Douglas and Mathewson, appear the following interesting comments, not without application today:

"The first and most fundamental of all Precaution (as I see it) is that the post of a Treater of Ores be filled only by one versed in the Art, and then only with license of the Authorities and after passing an Examination: the more so, because there are other trades under the obligation to do so, whose Errors are beyond comparison of much less importance. But little thought has been given to this, up to the Present, by the Owners of some mills, because to them it has seemed that what they lost of their own ores they still possessed for later treatment in the stored Tailings; and, in respect to the Ores of others, the worse they were treated the greater the advantage derived therefrom. Poor arguments are these both: the First on account of the doubled Work; the Second on account of being harmful to the Community, though not impossible to understand.

"Most weighty is the Confidence placed in the Metallurgists, because all the Riches produced by this most prosperous Land are entrusted to them, without reckoning or Account of what part thereof they are bound to return. Their Reputation is the only assurance of their Truth-telling as to what the ores have yielded. There is neither dispute over their sentence nor appeal from it; which is the strongest of Reasons why the urge of their own Interests may incite them to take of the yield unto themselves. Much need of a Christian Honour have they who enjoy these endless Opportunities, having, as the saying goes, "their hands always in the Dough," lest some of it stick. With much caution should one look upon him whom he would charge with the task of treating his Ores, because there is no bad Substance which might hinder recovery, nor any consumption or loss of Quicksilver (both frequent and sure causes of Loss) which can cause such loss as a Metallurgist with a bad Conscience.

"Nor is it alone sufficient that his good Habits be examined and approved, if there is lacking the necessary Knowledge of the Art which he must exercise. He must be able to recognize the Ores, their qualities and differences; to determine which are most fitted for Amalgamation and which for Smelting, or if there should be a combination of the Processes. He should know the harmful Substances which accompany ores, and should not be ignorant of the way to remove them. He should know the Accidents which may happen to Quicksilver, and the ordinary way of milling on a small scale. And, in all cases, he only can be considered as a treater of Ores, who knows at least how to make a small-scale Fire-assay of finely crushed Ore before amalgamating, in order to determine the Silver contained, and to know of a certainty and not through guesswork what he should recover. No Diligence should be omitted to secure this result.

"Many ducats has the ignoring if this Advice cost this Kingdom; and even to this day we pay the damages due to the disregard of that Precaution."

Cyaniding Gold Ore at the Ashanti Mine*

Improvements in Flow Sheet Recently Made Will Decrease Extraction but Increase Profits—Roasting to Remove Arsenic and Graphite Abandoned —Sodium Sulphide Leaching Adopted for Filter-Press Residue

THE Ashanti Goldfields Corporation, Ltd., operates a property at Obuasi, in the Gold Coast colony of West Africa, 124 miles from the coast, including the Ashanti, Ayeinm, and Justice mines. The Ashanti mine ore consists mainly of a hard quartz, varying in tint from milky white to sundry shades of gray; but the quartz is much mixed with a black, finely foliated schist, partly "sandwiched" with the ore and partly derived from the soft selvedge which forms a portion of the filling of the reef fissure. Some of the gold in the ore is free, but most of it is refractory, the average gold content of the ore milled for the last

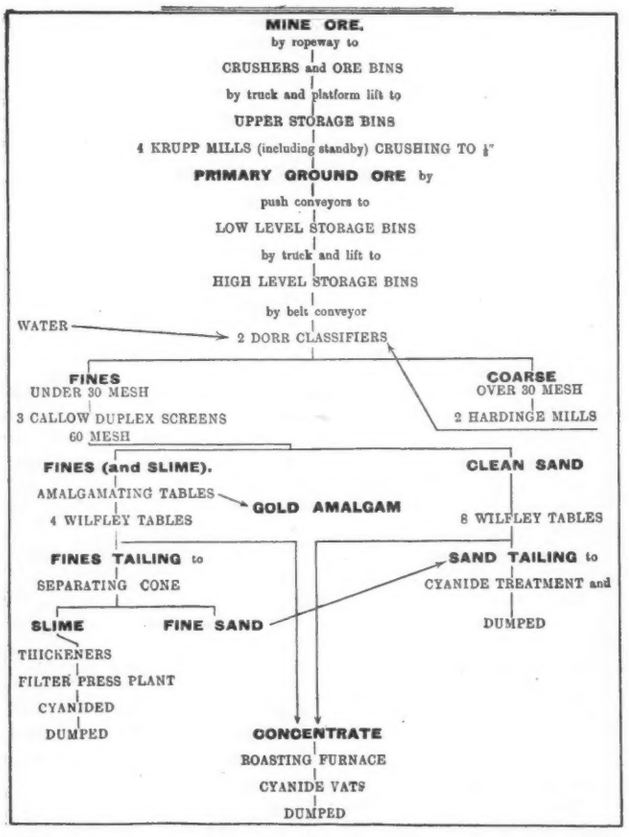


Fig. 1—Flow sheet used during greater part of 1922

year being 1.12 oz. The mixed ore contains at least two substances which are hindrances to the effective recovery of the gold. One of these is arsenic (in arsenical pyrites and also as arsenical iron or lollingite), and the other fine graphitic carbon, which is contained in the schist and is responsible for its black luster.

From October, 1909, until early in 1922 the ore from Ashanti mine was dried in rotary furnaces, ground in Krupp mills, and then roasted in Edwards' furnaces to remove the prejudicial constituents. The gold in the ground and roasted ore was amenable to a simple leaching with cyanide solutions without any further complications in treatment beyond the subsequent precipitation of the auriferous solutions, by means of zinc shavings, and the "cleaning-up" and smelting of the resulting gold precipitate.

Four Methods of Recovery

The main drawback to this relatively simple dry-crushing process, which for years yielded an extraction of well over 90 per cent, was the ever-increasing difficulty and expense of procuring sufficient suitable fuel for firing the roasting furnaces. A time finally arrived when the operators were compelled to recognize that, to treat continuously a reasonable tonnage of ore, it would be necessary to abandon the roasting process in favor of a raw treatment, which, although it would not yield so high an extraction, would ultimately prove a better method, economically, in that it would permit of more regular working and more consistent outputs.

Starting from this premise, a new plant was designed and erected, and from February, 1922, onward was gradually put into operation until in June it was so far completed that it could take over the whole work of treatment. In constructing the new plant, advantage was taken to the fullest practicable extent of the existing facilities for conveyance and handling of the ore, for utilization of the power and the pumping stations, and for the adaptation of available units of machinery, cyanidation plant, and other equipment.

There are four sources of gold recovery in the new treatment—i.e., amalgamation of the free gold, cyanidation of roasted concentrate, cyanidation of sand, and cyanidation of slime. There will soon be a fifth source to be included, when a system of post-treatment comes fully into operation. The various steps in the process will be described below, but the co-relation between the separate stages can best be gathered by studying the flow sheets. Of these, Fig. 1 shows the process as it has been used for several months, and Fig. 2 indicates how it will appear when various modifications and improvements, presently to be referred to, have been effected.

Crushing and Grinding in Krupp and Hardinge Mills

To liberate all the free gold and the bulk of the refractory gold, so as to render the former amenable to amalgamation and the latter to concentration, it is necessary to crush the ore to 30 mesh. The crushing is done in three stages: First, the ore as it comes from the mine goes to the breaker station, where it is screened on a 2-in. grizzly. The lumps which are too large to pass the grizzly are put through rock breakers. The screened and broken ore passes on to the second stage, which is the primary grinding. It is automatically fed into three Krupp mills (a fourth one being ready to work as a relief), which break the ore

*Abstracted from the annual report of the Ashanti Goldfields Corporation, Ltd.

down to granules of a maximum of ⅛-in. diameter. The action of a Krupp mill consists in rotating the ore with a heavy charge of steel balls, automatically screening out and ejecting the fine material and returning the oversize particles to the interior of the mill for renewed grinding.

The primary ground ore passes on to the secondary grinding plant. Here it is, first of all, mixed with water and delivered to two Dorr classifiers. The pulp is here roughly separated into two products, one finer than 30 mesh and one coarser than 30 mesh, which is delivered, with a small quantity of water, to two Hardinge pebble mills. From the Hardinge mills the pulp is returned to the Dorr classifiers to separate such quartz as is still not fine enough for treatment and to return it to the feed end of the mills. In the early practice, when crushing moist mine ore, the screens on the Krupp mills choked rapidly if anything finer than ⅛-in. mesh were used. It was also found that, on so coarse a feed and operating with lumps of mine ore, or, alternatively, local stream pebbles as grinding media, the Hardinge mills did not grind the desired tonnage. However, by the use of imported flint pebbles for the mills, the tonnage was increased to nearly 8,000 tons per month, allowing for ordinary routine stoppages.

Dorr Classifiers and Callow Screens Separate Coarse Product

The ground ore pulp overflowing from the Dorr classifiers carries, in addition to particles just fine enough for treatment (and, at present, a proportion which is rather coarser than desired), a considerable percentage of much finer sand as well as slime. (The slime is mainly impalpably fine clayey material derived from the schist. It is black, and, when partly dried, of a putty-like consistency). For reasons which will presently appear, it is desirable to separate the bulk product into two grades, the first being practically a pure sand (free from slime) and the other mainly slime, but mixed with a proportion of the finest sand. This classification is carried out in two stages. The pulp from the Dorr classifiers is run over three Callow duplex screening machines, each of which carries two traveling screen belts, about 2 ft. wide, supported and worked by rollers about 4 ft. apart. The fines here pass through 60-mesh screening into a collecting tray under the top half of the screen belt, while the relatively coarse sand is conveyed over the bottom end roller and washed into a chute. The two products from tray and chute, respectively, flow through launders and pipes to the next stages in the treatment. A second classification is applied to the fines after they have passed the amalgamating and concentrating tables. They still contain some sand, which, while it is fine, is not too fine to be treated by leaching in the sand vats and is too coarse to be effectively treated in the slime plant. For the purpose of this secondary classification a Caldecott cone was originally used (as on flow sheet 1) but this has latterly been replaced by a second set of Callow screens of 120 mesh, and a more positive separation of sand and slime is secured, with a beneficial effect on the sand treatment.

A further refinement in classification is projected, to be introduced when more pressing modifications have been completed. It will consist in passing the *primary* ground ore pulp over Callow screens so as to separate it into two products of over and under 30 mesh respectively, and bypassing the latter so as to keep it out of the Hardinge mill circuit. The effect of this will be to decrease the proportional feed to the Hardinge mills and to increase their duty. They can then be made to deliver a more uniformly fine product, which will make the sand tailing easier to treat.

Amalgamation of Fines Only

It is found that practically all the free gold accompanies the fines from the first set of Callow screens, except for a small quantity of coarse gold which is held up in the Hardinge mills and which is recovered from these when liners are being renewed. Only the fines are therefore run over amalgamated copper plates.

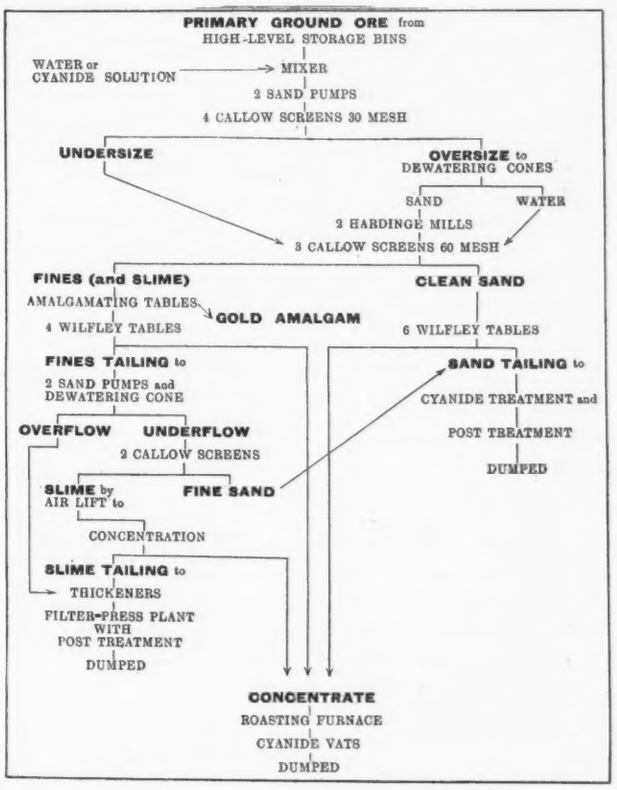


Fig. 2—New flow sheet to be adopted

At present, concentration is applied (separately) only to the two products from the first set of Callow screens. The fines pass over four Wilfley tables and the coarser sand product over six Wilfleys. The pyritic and arsenical mineral, with its associated gold, is separated fairly effectively from the sand but rather less effectively from the fines, as a noticeable quantity of very fine mineral escapes with the fines tailing and passes through the second set of Callow screens with the slime. It is intended soon to apply a secondary concentration to the latter product (see flow sheet 2), as this fine mineral interferes to a considerable extent with the cyanidation of the slime.

The concentrate from the two sets of Wilfleys is conveyed to an Edwards roasting furnace, which rids it of sulphur and arsenic and renders the refractory gold content amenable to cyanide treatment.

There are three different products treated by cyanidation—i.e., roasted concentrate, raw sand tailing, and raw slime tailing.

The roasted concentrate, after cooling, is placed into leaching vats, and cyanide solution is allowed to per-

colate through it for three weeks. The gold is effectively dissolved and is precipitated in the usual manner by running the charged solution through zinc shavings.

The sand tailing is caught in collecting vats and transferred from these to the sand treatment vats, where it is leached, for about six days, with cyanide solution. Occasional runs of high residues (bad extractions) have been experienced, which have been mainly due to the irregular working of the cone separation and to a consequently excessive amount of graphitic slime becoming mixed with the sand. An improvement is noticeable since the second set of Callow screens was substituted for the cone separation, and a further improvement will soon make itself felt as the result of post-treatment—which will be referred to below.

The slime treatment has so far been the least satisfactory department of the plant. The slime pulp is run into settling or thickening tanks and from these is pumped into the filter presses. The actual cyanidation has not been applied until the slime is in the form of cakes in the presses. Arrangements are now nearly completed which will permit of the ore being crushed with cyanide solution, which will give the slime an effective contact and agitation with the chemical before it goes to the presses. The difficulties in the slime treatment which have to be, or have had to be, overcome by this and other remedial measures are as follows:

1. Irregular running of the cone separation has allowed sand to become mixed with the slime pulp. This is remedied by the installation of the second Callow screen set.

2. The gluey or colloidal consistency of the slime and its tendency to gelatinize on first coming in contact with alkaline cyanide solutions. This gelatinization caused the press cakes to become impermeable to anything like a free flow of the treatment solutions and greatly retarded the solvent action of the cyanide. A gelatinization while the slime is floating free in the pulp (as when crushing with solution) will not be nearly so detrimental.

3. The presence of fine arsenical mineral in the slime is a trouble which will be largely overcome by the projected installation of auxiliary concentration.

4. The presence of graphitic carbon. This will be dealt with in the paragraph on post-treatment.

5. The capacity of the filter-press plant, working under the original conditions, was insufficient to deal with all the slime plus a considerable proportion of sand, and part of the pulp has had to be run to waste. The remedies for 1 and 2 will also serve to get over this difficulty by: (*a*) removing the sand, and thus reducing the proportion of material requiring to be treated as slime, and, (*b*) effecting a great part of the treatment before the slime arrives at the presses, thereby lessening the time required for treatment in the presses.

Post-Treatment Plan To Be Adopted

Several references have been made to the presence in the ore of graphitic carbon. This substance, of which there is some in the sand tailing (even after the Callow screen separation) and much more in the slime tailing, has a pernicious effect in cyanidation. As fast as the gold is dissolved from the sand or slime, some portion of it is reprecipitated, as a gold-cyanogen compound, on the carbon, from which it cannot then be removed by cyanide solution. A considerable proportion of such reprecipitated gold can, however, be recovered by a post-treatment, applied after the cyanide has dissolved all it will dissolve and before the residue is discharged from the vat or the filter press. The post-treatment consists simply in leaching the sand or slime residue with a solution of sodium sulphide. This dissolves the gold-cyanogen compound above referred to, and the gold in the sulphide solution is precipitated on copper shavings. The post-treatment of the sand tailing was begun in December, and the results so far have been satisfactory. The post-treatment of the slime was to be started in January. Working-scale tests have shown that it will be a profitable supplement to existing methods.

At the annual meeting of the company, held on Feb. 20 in London, the chairman stated: "The forecast of improvements is on the eve of fulfillment. Post-treatment of the sands is now in operation, and is yielding about 1½ to 2 dwt. more than it was for the period covered by the report. Crushing with cyanide was to commence about the middle of February. Even without this aid it was found that post-treatment of the slime extracted about 1 dwt. of gold additional, so that by now the total extraction from all sources should have reached the preliminary standard of 80 per cent. Of course, 80 per cent is a big drop from over 90 per cent—as our extractions used to be from dry crushing —but at 80 per cent the new and cheaper process will give us quite as good an economic result on balance, and will ensure greater regularity in output, which was our main object in making the change. Moreover, there is no reason to anticipate that 80 per cent is going to be the limit of our wet-crushing extractions, as many minor improvements are likely to suggest themselves in the course of regular work, now that we have the chief alterations and modifications out of the way."

Bismuth in 1922

The quantity of bismuth sold in the United States in 1922, according to figures compiled by the Department of the Interior through the Geological Survey, was 226,385 lb., and the average price was $2.26 a pound. The quantity sold included imported and domestic bismuth that was recovered in refining lead and tin bullion at three plants in the United States. About 300,000 lb. of bismuth was recovered at these plants in each of the last two years. The chief source of the bismuth recovered from tin refined in the United States is Bolivia; the chief sources of that recovered from lead are Mexico and the western states.

London and New York are the principal centers of the market for bismuth. New York supplies the domestic consumers, most of whom are manufacturers of medicinal chemicals in the vicinity of New York, Philadelphia, and St. Louis.

Domestic Pyrite Industry Not Flourishing

The output of pyrite in the United States in 1922, according to the U. S. Geological Survey, amounted to 169,043 long tons, somewhat more than the output in 1921, which was 157,118 long tons, but the value was considerably less. The imports in 1922 were 269,947 tons, an increase of 53,718 tons over those in 1921.

Nearly all the pyrite marketed was produced in California and Virginia. The future of the domestic pyrite industry, except at a few places that are favorably situated, is not promising. Domestic pyrite cannot, under normal conditions, compete in markets on the Atlantic seaboard with sulphur or with Spanish pyrite.

The Human Element in Labor Cost

Showing How a Company May Fail, Even With Improved Methods and Machinery, Where Individuals Have Been Able to Carry on Operations

By W. F. Boericke
Mining Engineer, Chicago

W. F. Boericke

SOME YEARS AGO one of the large mining companies in the country made a heavy investment in zinc properties, actual and prospective, in a district where leasers had made considerable production in the past. Although none of the latter individually had ever made a large shipment, in the aggregate their total amounted to a really impressive figure. This production had apparently been obtained by the crudest mining methods; equipment and machinery at the little plants might have been copied direct from Agricola's woodcuts, and it is certain that if the shade of that eminent engineer visited the district, he would have noticed many home-made devices which he had painstakingly described several centuries before.

Bearing all this in mind, and fortified with their geologist's opinion that there was a large amount of ore yet untouched in the ground, of the same character and mineral content as that which the leasers had mined, the company felt that, with modern mining methods, unified overhead expense, a central power plant, labor-saving machinery, and competent management, a good profit could be made from ground rejected by leasers as too lean to work, though ordinary ore should show a large margin over the mining costs.

Accordingly, the mills were redesigned or rebuilt entirely to take a greatly increased tonnage; old shafts were retimbered and caved drifts opened up; tracks were relaid with wider gage and heavy steel, and drills replaced the old single and double jacks, and a superintendent was put in charge who counted that month wasted which did not show more cars hoisted and a reduction in working costs.

At the end of six months, the superintendent offered his resignation, and the company was ready to quit. The operations in the district, almost without exception, had failed to show a profit.

Operations Efficient But Costly

Yet there was nothing in the operation of the mines or mills to which one could point an accusing finger. The mills had run steadily without a serious interruption. In the mines, the drillmen had broken an average amount of ground; cars had been loaded on contract at customary rates paid in other camps; the wage scale was fair, but somewhat lower, if anything, than that prevailing in the mines 50 miles south. There was no excessive overhead, nor high cost for supplies or for power. In fact, the working cost was creditable. Yet the cost per ton of concentrates was usually more than the ore was worth on the market.

"There's too much attention to tonnage, and not enough to mining pay ore. Run up the grade of the dirt." This was the obvious answer from the general office when the returns from the first months were in. Accordingly, the superintendent tried some selective mining. Lean ground was cut out; drifts were narrowed up and kept in richer ore.

The grade of the dirt moved up 1 or 2 per cent, but the mining cost marched right up also. The shovelers complained that there wasn't enough ground broken for them to make wages on the old scale, and demanded an increase in contract rates. The drillers were unable to pull the ground because stopes were small and confined to the better ore. The millmen roared because of no dirt, and had trouble holding their beds on the jigs. They compromised by running only when the hopper was full, and put in the remainder of the shifts discussing, on company's time, the chances for the local baseball team.

Results Disappointing

The end of the month showed more concentrates made, but no better showing on the profit-and-loss sheet.

The general office then put the problem up to the superintendent. "Tell us what's wrong," they said. "You have a better equipment, both in mine and mill, than the leasers had before you. The same sort of ore in the ground as they worked on. Most of the men who formerly leased the ground are now in your employ, as shovelers or drillmen, and their records show they are good workers. Now, why were they able to make a profit on this ore for years, with their obsolete methods and limited production, while we can't break even?"

The statements of the general office were all obviously true, with one important exception. This was, that the leasers in former years had made a *profit* by the mining. The leasers themselves would probably have been the first to declare that their mining had been profitable. Otherwise, they would say, indignantly, Why would we have worked the diggings for the last five years?

Therein lies the curious psychology of the mining temperament, which, by failing to realize and interpret it, cost the big company almost its entire investment in this field, and taught the superintendent that figures, alone, without considering the human element, can be deceptive.

For in an economic or even a business sense of the word, those leasers had never made a cent of *profit* from their operations. True, they paid for their powder, steel, supplies, and their milling charges, and from the sale of their ore they had a surplus left, which was divided between them on a partnership basis. But this was not a *profit*, because they had not previously credited themselves with an amount to which they were rightfully entitled as ordinary wages. Had they done this,

allowing themselves the same rate per day as they could have obtained at any mining camp, this "profit" would have vanished at once.

Reasons for Leasers' Activities

Conceivably, when the season's clean-up of concentrate was sold to the ore buyers, and current bills paid, and the "profit" divided, a good many leasers realized that they had put in a hard season's work for little money. But next year found them ready and anxious to try it again. Why? The miner's temperament, the eternal optimism which makes him believe that this next year will be the lucky one, when a new range will be found which will mill out big. For the pleasure of being his own boss, of directing his own work, and selling his own ore, he will eat candle grease and powder smoke; he will follow a thin sheet of lead on his hands and knees in drifts a scant three feet high; he will uncomplainingly face dangers and discomforts to which the most calloused operator would refuse to subject his men. The results are that he gets out the ore, often a substantial amount of it, at a labor cost generally vastly disproportionate to the work and risk entailed.

For instance, the pitch opens up into a rich streak along the hanging wall, a long way from the nearest track. Will it pay to run the track over? A few holes will show its permanency. The ore that is shot out is loaded into wheelbarrows or candle boxes, and packed back with infinite toil to the nearest car. That is, if it belongs to Bill Treman, who is leasing. But if it belongs to the American Ore Co., will Bill break his back to carry that ore? He will not. He expects that the ground boss will run over with a track, and he wants the cars well greased.

In short, when the leaser goes to work on company time, he expects to receive customary wages, and expects to give customary work—no more, no less. If the company has been optimistic enough to believe that it will get the same work done for the same cost when Bill is on the payroll, as when Bill was a free-lance operator himself, it is due for a rude jolt. This does not decry the need for modern organization and management which are adapted especially for large-scale production output, with lessening of overhead charges per unit.

Before planning on larger-scale production, it is essential to know under what geological conditions the ore occurs in a district, and what has been the history of previous mining. The mere fact of a large production from the field will not in itself mean that a big company with a large overhead can go in and attain success. The labor cost is about 60 to 70 per cent of the average mining cost. Unless the company sees how it can cut the cost of the labor item, as determined from previous mining experience in the field, it will not avail much to cut the rest of the cost. Take the simplest case, where the mining cost was $1 per ton, divided 70 per cent labor and 30 per cent supplies, powder, power, and overhead. A reduction of 10 per cent in every item except labor would be only 3c. per ton; but even a 5 per cent reduction in labor would be more than this.

Hence, it is important to know, in analyzing the cost figures, on what basis the labor cost was computed, particularly the time or contract rate paid the men. We might have, from the old cost figures, a cost of 70 per cent per ton for labor, but if this was based on $2 a day labor, only the most optimistic manager would expect to cut this figure if he had to pay a modern scale. Of course, a low wage scale generally implies inefficiency and poor work, but, unfortunately, a high wage scale, *per se*, does not always indicate the reverse unless conditions are right.

Furthermore, a low wage scale need not imply inefficiency at all. Many of the old lead "diggings" of Wisconsin and Illinois were apparently worked on an unbelievably small margin of profit. Drifts were run with hand-steel in hard gray limestone for a stringer of lead that today does not look worth mining. How were men obtained for such work, especially on a wage basis? Undoubtedly, because rather than be idle during the long winter months, the early settlers, without modern movies and mail-order catalogs to pass the time, would turn to lead mining as offering some live interest and possible profit until spring set in. About all they had to lose was their time, and any wage above actual operating cost was profit.

Even when fairly reliable records are kept, and the wage basis is definitely known, it pays to look a little deeper. I remember a particularly interesting case in my experience. A certain zinc mine had made a good production for years by mining methods that savored of the Dark Ages. There were a number of shallow shafts, with gasoline hoists scattered over the lease. The ore was all broken with hand-steel, hand picked underground, hoisted, and taken by wagon to a small central mill, where it was concentrated and shipped to market. The crew was made up of native miners, good men, who knew the ground, and gave a good day's work for a small but sure pay check. Steady jobs were scarce in the district, and the management was able to pick the men it wanted.

On the basis of its seemingly successful record, a large outside company bought the mine, and, after completely overhauling the plant, started operations. The old wage scale was maintained, and the same crew kept on the job.

The new company did not break even for a single month, and after a year's trial, gave up the hopeless job. During this period, however, those responsible for its management had a chance to analyze the old company's figures. They discovered the interesting fact that the latter also had never made a book profit. But the old company (which was entirely a one-man affair) owned a large retail store in town, where everything was sold from candles to overcoats. The men's checks were cashed at this store, and enough pressure (not so quiet, either) had been put on the men to insure their spending the greater portion of their pay there. Most of them were in debt to the store at the end of the month. Apparently the profits from this sort of business were sufficient to turn the operating deficit at the mine into a profit for the owner of both enterprises. But as the store was not, unfortunately, for sale, the new company was unable to try this ingenious experiment in mining economies, even had it been so inclined.

Italy Important Source of Bauxite

Italy's production of bauxite has been materially increased by the annexation of the Istrian Peninsula. Whereas for the six years from 1916 to 1920 the quantity of bauxite mined averaged less than 8,000 tons, according to *Commerce Reports*, in 1921 it grew to 49,120 tons, of which 46,000 tons was produced in the Trieste district, and in 1922 a further increase was recorded. Though no official figures are available, it is known that a fair export trade is being developed.

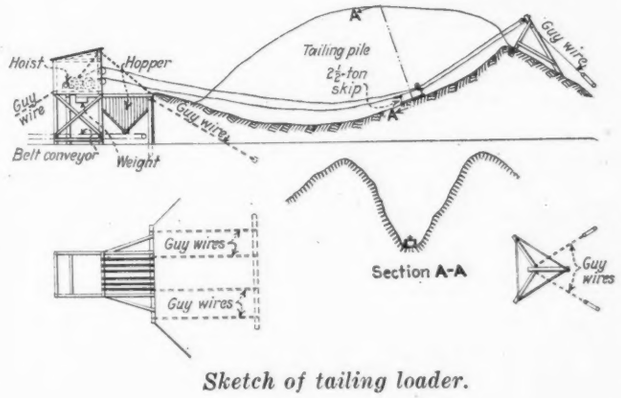
The Replogle Magnetic Tailing Re-treatment Plant

Material Accumulated During War Averaging 25 Per Cent Iron Now Being Reclaimed—Magnetite First Removed From Dried Feed With Magnetic Separators—Pulp Then Tabled—Latest Types of Electrically Vibrated Screens Used

BY W. R. CANTON

THE RECLAMATION AND RE-TREATMENT plant of the Replogle Steel Co. to be described has been erected at the Replogle mine of the company near Wharton, N. J. It is about 60 miles west of New York and 2½ miles from Dover, N. J. This property was developed during the war, and at that time there was no wet mill to treat the magnetic tailing. This tailing ran about 25 per cent in iron and was stacked with a view to re-treatment when the wet mill was completed. The iron occurs as disseminated magnetite and martite. The martite is non-magnetic, and must be recovered by water concentration; and owing to the fact that fine grinding was not practiced during the war period, considerable magnetic iron also was contained in the tailing. To treat this tailing it must first be dried, for the moisture runs as high as 12 per cent after a rain, and it will not screen. The material is brought to a loading bin by a drag-line scraper of two and one-half tons' capacity, operated by a double-drum air hoist. A sketch of the general layout is shown in the illustration. The bin and A-frame are shown.

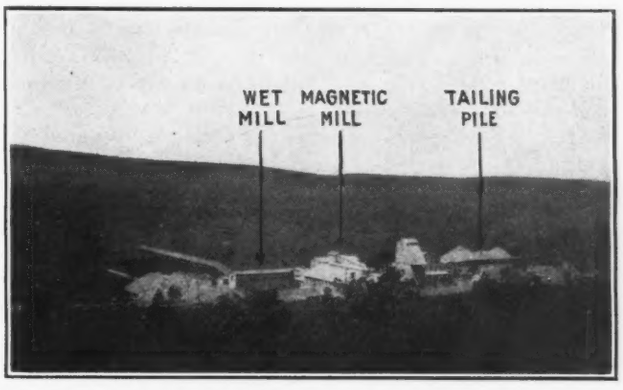
From the loading bin the ore is conveyed to an elevator that delivers it to a coal-fired drier of the tower type. After passing through the drier it is elevated and run over a trommel screen with $\frac{3}{8}$x$\frac{3}{4}$-in. slots. All of the tailing passes this screen except the refuse, which is carried over and wasted. The 5x5-ft. drier has a capacity of about thirty tons an hour when the ore is extremely wet, and up to eighty-five tons per hour when it is fairly dry. After passing this screen the ore drops to a conveyor, which carries it over a weightometer before delivering it to the trommels above the magnetic-mill bins.



Sketch of tailing loader.

Two 60-in. x 16-ft. trommels having a slope of 1⅜ in. per foot and a speed of 15.6 r.p.m. receive the feed. They consist of a main screen and a jacket and they make four products.

The main screen has $\frac{5}{16}$x$\frac{5}{8}$-in. slots. The jacket is in two sections, the first of which has $\frac{5}{16}$x$\frac{1}{2}$-in. slots, whereas the second section has $\frac{1}{8}$x$\frac{1}{2}$-in. slots. The through product from the first section of the jacket is



General view of Replogle Steel Co.'s Scrub Oaks plant.

sent to two Newaygo screens. These screens are equipped with 10-mesh cloth, delivering a standard 14-mesh product. All the products from this set of screens drop into a 10-compartment ore bin of 1,000 tons' capacity. From this bin the ore is fed through rack and pinion gates. The coarser sizes of ore, sections 1 and 10 being through $\frac{3}{8}$x$\frac{3}{4}$-in. and plus $\frac{5}{16}$x$\frac{5}{8}$-in. slot, and sections 2 and 9 being minus $\frac{5}{16}$x$\frac{5}{8}$-in. and plus $\frac{1}{8}$x$\frac{1}{2}$-in. slot, are bypassed direct to the regrinding unit without any attempt to run them over the magnets.

The next finer sizes, sections 3 and 8, minus $\frac{1}{8}$x$\frac{1}{2}$-in. slot and plus $\frac{1}{16}$x$\frac{1}{2}$-in. slot, are fed to Hum-mer screens, because the trommels do not give a clear separation and carry over a large percentage of fines to these products. These screens are equipped with 10-mesh cloth and deliver a standard 14-mesh product. The undersize is treated on a single-deck belt-type magnetic separator. This machine uses about 4.4 amperes and makes two products: a 58 per cent iron concentrate which goes to the shipping bins and a tailing which joins the oversize from the Hum-mer and is bypassed to the regrinding unit. At first this undersize was sent direct to the wet mill, as it was fine enough to treat on the tables, but experiments have shown that a second treatment by the magnetic machines will yield more commercial concentrate and also relieve the wet mill.

The oversize from the Newaygo screens, in sections 5 and 6, is fed to two double-deck belt-type magnetic separators, so arranged that the tailing from the upper deck becomes the feed to the lower deck. About four amperes are required by each deck, each being equipped with twelve magnets. These machines make a 59 per cent shipping concentrate and a tailing that is sent to the regrinding unit.

The undersize from the Newaygo screens, in sections 4 and 7, is fed to two 30x36-in. Ball-Norton drum-type magnetic separators. These separators run about 30 r.p.m., and are double decked, so that the tailing from the upper drum becomes the feed to the lower drum. The upper drum takes about 11 amperes and the lower drum about 10 amperes. The drums of these machines,

and of all other machines of the same type in the plant, are covered with a two-ply endless rubber belt. This belt is pierced with ⅝-in. nails spaced ¼ in. centers to increase the intensity of the field. These machines make a 60 per cent shipping product and a tailing that is sent direct to the wet mill for treatment.

The Flow Sheet of the Regrinding Unit

The tailing from the primary sections is elevated by a 14-in. bucket-belt elevator and delivered to a small distributing bin. This elevator has a belt speed of 192 ft. per minute. From this bin the ore is fed by rack and pinion gates to four sets of 42x16-in. Allis-Chalmers rolls. They will handle from five to six tons each per hour of this feed.

After passing the rolls the material is elevated by another 14-in. bucket-belt elevator having a belt speed of 226 ft. per minute. This elevator delivers the material to a set of electric vibrating screens. This screen unit embodies both of the latest types of electric vibrating screens side by side. There are two Mitchells and one Tyler 6-ft. Hum-mer. All are equipped with a cloth that yields a 14-mesh product. The oversize from these screens is reground by two 42x16-in. Allis-Chalmers rolls, and after passing them becomes the circulating load and is returned to the screens.

The undersize from these screens is fed to two double-deck 30x36-in. and one double-deck 42x30-in. Ball-Norton drum-type magnetic separators, so arranged that the tailing from the upper deck becomes the feed to the lower deck. The upper deck takes about 11 amperes and the lower deck about 10 amperes. These machines yield a 60 per cent shipping concentrate and a tailing which is sent to the wet mill.

Flow of Pulp in the Wet Concentrator

The wet concentrating plant is equipped with two units of four sections each. All of the tailing from the magnetic plant is delivered to a 14-in. bucket-belt elevator having a belt speed of 324 ft. per minute. This elevator discharges on to a 16-in. belt conveyor running 380 ft. per minute. This conveyor is equipped with a self-propelling and reversing tripper that distributes the ore to the bins. The working capacity of this bin is about 300 tons, or about six hours' run for the wet mill.

From this bin the ore to each section is fed at the rate of about seven tons per hour to an ore-wetter, which delivers it to a launder classifier. The sand from this classifier is treated on a Wilfley No. 9 double-deck rougher table, which handles about six tons per hour. The classification is made at about 60 mesh. These rougher tables make three products, a commercial concentrate, a middling, and a final tailing.

The middling, amounting to probably less than 20 per cent of the Wilfley feed, is re-treated on Deister sand tables. These tables make two products, a shipping concentrate and a final tailing. The classifier overflow, amounting to about one ton per hour, goes to a small dewatering cone, where it is settled and dewatered. The amount of water in the material fed to the table is controlled by the use of different size bushings in the cone discharge. The feed from these dewaterers is treated on Deister sand tables, making two products, a commercial concentrate and a final tailing.

Both tailing and concentrate are dewatered by drag classifiers of the Federal-Esperanza type. The concentrate passes by conveyor to the shipping bins and the tailing to the tailing storage trestle. The overflow from the dewatering cones and the drag classifiers goes by tile sewer to a reclamation pond, where the water is pumped back to a muddy-water tank of 80,000 gal. capacity.

In milling this magnetic tailing much magnetic material is liberated owing to the fine grinding, so that about 43 per cent of the concentrates produced comes from the magnetic plant.

An analysis of the different products shows:

Feed to the magnetic mill, 24.66 per cent Fe.
Concentrate from magnetic mill, 57.87 per cent Fe, 12.76 per cent SiO_2, 0.042 per cent P.
Tailing of magnetic mill (feed for wet mill), 18.18 per cent Fe.
Concentrate of wet mill, 60.65 per cent Fe, 8.80 per cent SiO_2, 0.117 per cent P.
Wet mill tailing, 6.67 per cent Fe.
Concentrate from shipping bin, 59.24 per cent Fe, 11.78 per cent SiO_2, 0.086 per cent P.
Ratio: Magnetic mill, 6.11; wet mill, 4.68; general mill, 2.92.
Recovery: Magnetic mill, 38.2 per cent; wet mill, 71.1 per cent; general mill, 82 per cent.

The mixed concentrate is finer than desired, and it must be sintered before being sent to the furnaces. By separating the dry concentrates it is possible to make a bessemer ore, but the mixed product is a non-bessemer ore.

Increased Production of Magnesite in 1922

The production of crude magnesite in the United States in 1922 was 32 per cent greater than that in 1921. It amounted to 63,487 short tons, valued at $650,742, according to figures compiled by James M. Hill, of the U. S. Geological Survey. Practically all the magnesite mined in 1922 was obtained from deposits in California, though a little was mined in Washington during the latter part of the year, and some calcined magnesite was shipped from stockpiles at Valley, Wash. The largest producer of magnesite in California was the Western Magnesite Co., which operates the Red Mountain mine, south of Livermore, in Santa Clara County; the second largest producer was the Sierra Magnesite Co., whose mines and mill are near Porterville, Tulare County. The magnesite mines near Rutherford, Napa County, operated by C. S. Maltby, ranked third; and a small output was made from mines near Piedra, Fresno County; Sampson, San Benito County; Morgan Hill, Santa Clara County; Gustine, Stanislaus County, and Exeter, Tulare County.

Figures showing the imports of magnesite since the tariff act of 1922 went into effect (Sept. 22, 1922), have not yet been published. The imports during the part of the year prior to that date amounted to 112,159 tons, valued at $1,757,636, as compared with 42,486 tons, valued at $592,491, in all of 1921.

No crude or calcined magnesite was exported in 1922. The exports of magnesia pipe and boiler coverings and other manufactures during the year amounted to 3,831,681 lb., valued at $223,686.

More than 90 per cent of the domestic magnesite produced in 1922 was sold in the calcined form and brought from $30 to $50 a ton. A small quantity sold crude for chemical uses was priced at $10.50 to $12.50 a ton. The prices quoted on domestic magnesite were about $10 a ton throughout the year.

The assurance of good prices upon the passage of the new tariff act greatly stimulated the domestic industry. Many deposits in California are being reopened, and additional equipment is being installed at calcining plants. There is also renewed activity in the Stevens County field in Washington. All magnesite operators are optimistic as to the future of the industry.

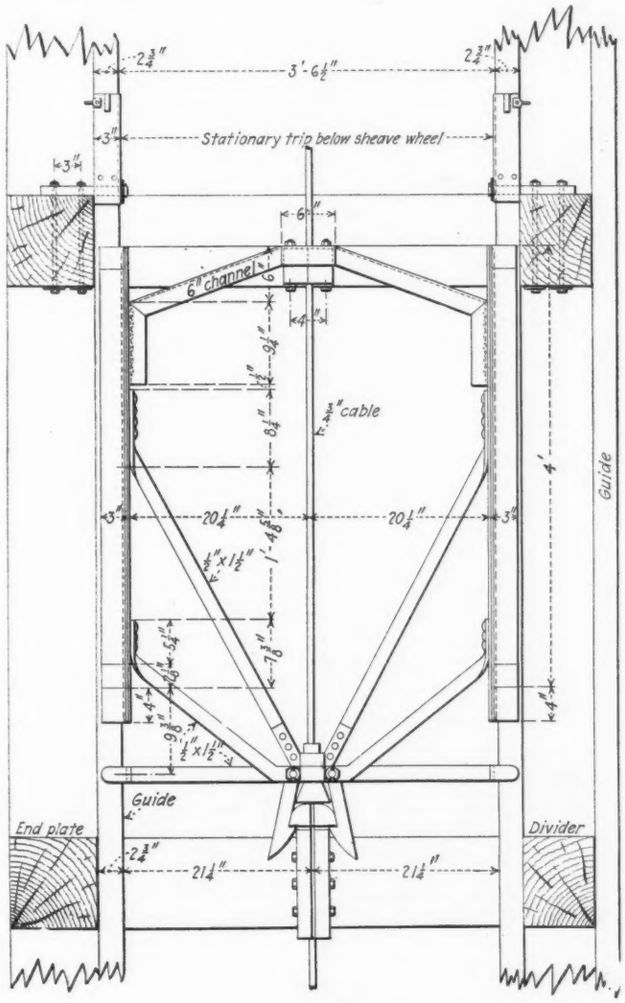
USEFUL OPERATING IDEAS

Improved Safety Crosshead for Bucket Shafts

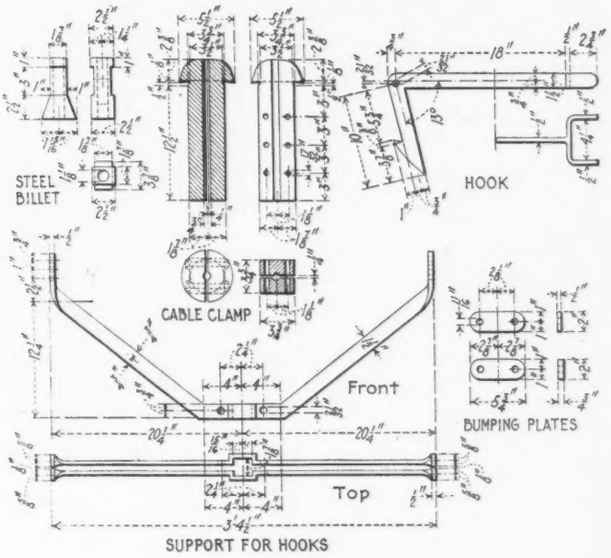
BY HORACE F. LUNT
State Commissioner of Mines, Denver, Colo.

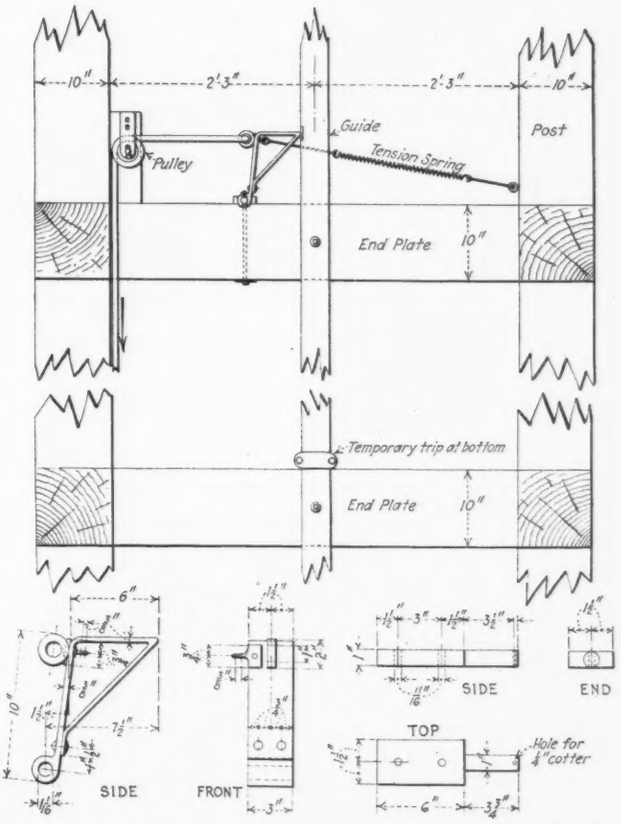
In an article in the *Engineering and Mining Journal* for April 3, 1920, James E. Harding pointed out the danger of using a "floating" crosshead in bucket shafts, and described a safety crosshead which was fastened to the hoisting cable, but which could be released so that the bucket might be lowered below the timbers. Previously a somewhat similar device known as the Calkins crosshead had been used, but this, I believe, has never been described in print. It was built of wood and was much heavier than the one described by Mr. Harding.

About two years ago, when the shaft of the Portland Gold Mining Co. was being sunk, R. B. Emens, the mine



Safety crosshead of steel, used in shaft of Portland Gold Mining Co.





Safety catch for steel crosshead. Above, other details of crosshead

engineer, under the direction of Fred Jones, the superintendent, designed a crosshead similar to that described by Mr. Harding. The chief difference was that the forked ends of the hooks worked below the shoes

directly on the guides. This simplified the device by doing away with the "tripper rods." The crosshead, as thus constructed, was not satisfactory. The guide shoes were short, and this caused a tendency to jam between the guides, and the forks of the hooks lacked sufficient bearing surface to remain constantly on the guides.

Recently a new crosshead was designed, the plan of which is illustrated, which obviates the difficulties had with the old one. The long guide shoes do away with any tendency to jam, and the running position of the forks of the hooks is such that a maximum bearing surface is available to hold them on the guides while the crosshead is in motion.

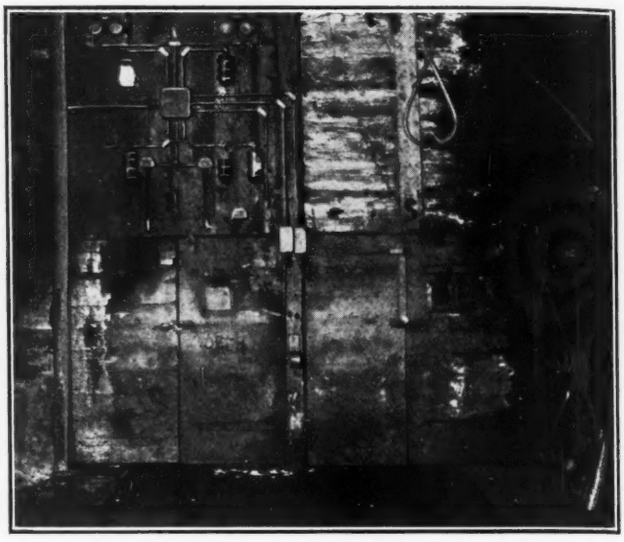
The cable clamp shown may be placed at any desired height above the bucket and is an improvement over the socket shown in Mr. Harding's original design, as it would seldom or never be desirable to have the bucket immediately under the crosshead. The plans also include a new device by which the crosshead can be hung up under the sheave wheel, when the bucket is to be dumped, and released by the hoistman after dumping. This was designed by Mr. Emens. The crosshead as shown has been in use for several months and is giving entire satisfaction.

Shaft Signaling System at Ironton Mine, Bessemer, Mich.

By W. H. Carrick

The Ironton mine, near Bessemer, Mich., is served by two shafts, an incline, No. 4, and a vertical, the Corrigan. The latter is steel-timbered and is up to date in every respect. Signaling devices and other equipment have been installed to make it as safe as possible. The shaft signaling system used is described briefly as follows:

Placed in front of the engineer on the cage hoist are two boxes with glass fronts, each box having eight compartments. Red and green glass are used in the two top compartments and white glass is used in the others. At the top landing there is an iron gate; likewise at the dryhouse landing about 15 ft. below the collar. At the 19th level tight wooden doors and an iron gate are used. Whenever any one of these gates or doors is open, the red light glows in the box in front of the engineer corresponding to the compartment of the shaft involved. At the same time red lights glow at every level. This indicates to anyone desiring the cage that there is a door open and that probably the cage is in use. It tells the engineer that he must not move the cage until the green light glows. When all doors are shut the green light glows. In this way there is no danger of the cage being taken away from a person about to step aboard.



Station at 19th level, Corrigan shaft, showing doors of cage compartment; also signal bells and lights

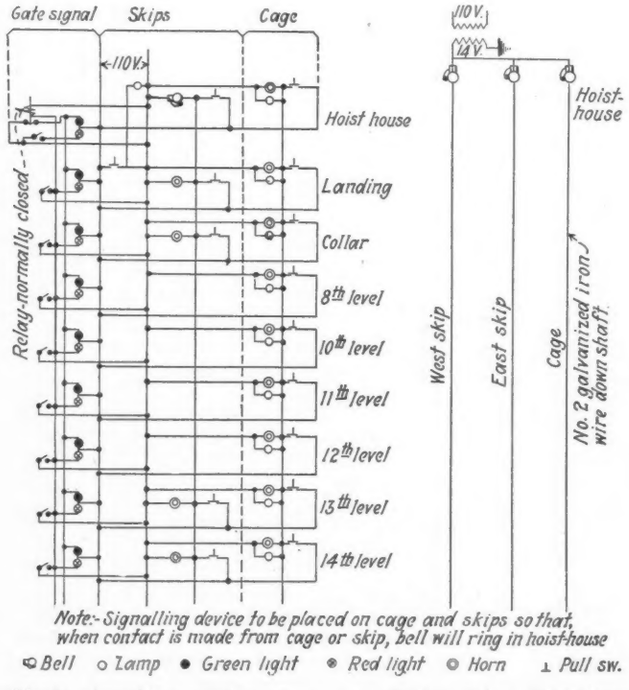
After stepping aboard the cage at the 19th level one can reach up and signal the engineer as to the place to which one wishes to go. These signals are all of the pull type. They are reproduced on each landing and at the hoist by both a bell and a light. In the No. 4 shaft a horn of the Klaxon type is used. At the 19th level there is a pull signal outside the door, in addition to the one in the shaft, so that the doors need not be opened to send a signal.

This system of signaling the movement of the cage is duplicated for the skip.

Both the system of red and green lights and the skip and cage signals are operated by a 125-volt current. All wiring outside the cable is carried in iron conduit.

Suspended in the shaft in each cage compartment and in one of the skip compartments is a standard trolley wire, attached to the timbers with trolley wire hangers. This line carries a 14-volt current. On the cage is placed an arm which can move to contact with this wire. This operates a relay and a bell in the hoist house. The current grounds through the rope and the hoist. In this way, should anything happen on the cage, the engineer can be signaled from the moving cage or skip. It also facilitates movement of cages and skips in shaft repair work.

The accompanying drawing gives a diagrammatic sketch of the system in use at the Tobin mine of the same company. That of the Ironton mine described here is similar.



Shaft signaling system in use at Tobin mine, Michigan

Technical Papers

The Engineering and Mining Journal-Press cannot undertake to supply copies of the publications mentioned on this page. All requests should go to the publishers, whose names and addresses are given, with the price, when known.

The Slate Industry — To assist the slate quarry man, or miner, to reduce his production cost, to improve the quality and increase the variety of his products, and thereby to promote efficiency in the slate industry is the purpose of Bulletin 218 of the U. S. Bureau of Mines, entitled "The Technology of Slate" (obtainable free from the Bureau at Washington, D. C.). The author is Oliver Bowles. The pamphlet contains 128 pages and is by far the most comprehensive treatise on the subject that we have seen. Every feature of the industry is discussed, including general geology, uses, distribution, methods of quarrying, initial manufacturing processes, and methods of grinding. The most practically useful part of the book is that dealing with the problem of waste. Suggestions are made for the methods of quarrying that are most likely to recover the largest proportion of the output in such condition that it can be used for purposes that require slate in slab or sheet form. The author has spent many months in studying actual quarrying operations in different districts, and he is convinced that the proportion of preventable waste is large. The second problem, after the waste in quarrying is reduced to the minimum, is to develop outlets for granulated and pulverized slate, whereby scrap is utilized and the net loss is lessened. The most promising field is the use as an inert filler in such products as paper, rubber, road asphalt, linoleum, window shades, and paint. For such purposes, of course, a finely ground product is required. Slate granules are used for the making of prepared roofing.

The preparation of such bulletins as this one of Mr. Bowles does much to justify the expenditure of public money for the Bureau of Mines and similar organizations. At first thought it may seem that the slate producer is the man to profit. As a matter of fact, it is the public that gains, because eventually the economic saving in any industry is reflected in the cost of things to the ultimate consumer — namely the man who pays the taxes.

Economic Geology — *Economic Geology* for March (Lancaster, Pa.; price, 65c.) contains: "Metallogenetic Zones," by R. H. Rastall, pp. 17; "Primary Chalcocite: Bristol Copper Mine, Connecticut," by A. M. Bateman, pp. 45; "Capillary Relationships of Oil and Water," by C W. Cook, pp. 6; and "Geological Distribution of the Important Ore Deposits in Japan," by M. Watanabe, pp. 17.

Chloride Volatilization—"The Chloride Volatilization Process of Ore Treatment," Bulletin 211 of the U. S. Bureau of Mines, Washington, D. C., pp. 106, obtainable free on request, will interest a large number of metallurgists, and is the most complete and authoritative discussion of this subject that has yet appeared. The process, of course, is not new; in the first part of the bulletin Stuart Croasdale summarizes what has gone before. In 1916 research work on chloride volatilization was begun at the Intermountain experiment station of the Bureau of Mines, in co-operation with the metallurgical research department of the University of Utah. Since then this work has become the major investigation of the Intermountain station. At first only small-scale tests were run, but latterly the installation has been of a semi-commercial size, and special machinery has been devised. Tests have been made on a large variety of ores, and the work has even been carried on at other plants, as at the Yellow Pine, at Goodsprings, Nev., and at the Pope Shenon plant, near Salmon City, Idaho. In fact, so much data has been secured that the present bulletin covers only the most indicative and interesting of the tests. As these are still being carried on in a broader way than ever, a more complete report will no doubt be issued later. The chloride volatilization process is peculiarly adapted to the treatment of oxidized or carbonate ores that cannot be treated to advantage by processes now in use. Lead is the most easily volatilized of all of the metals to which the process has been adapted, but silver, gold, copper, and zinc can also be volatilized and recovered under the proper conditions, and complex ores of these metals form a most interesting problem. The Cottrell process of fume precipitation is used, and without this method of recovering the fume, it is probable that volatilization would hardly have appealed to the Bureau's metallurgists as worthy of such extensive investigation. The work is decidedly worth while.

Blanket Concentration of Gold—In the *Journal of the Chemical, Metallurgical and Mining Society of South Africa*, for February (Johannesburg; price 3s. 6d.) is a seven-page article, with discussion, on the "Recovery of Gold by Blanket Concentration in Substitution of Plate Amalgamation." In South Africa, for many years, blankets of corduroy cloth have been used as an auxiliary to plate amalgamation, and in some instances in place of plates in the stamp mill.

Gas Masks—Technical Paper 300, pp. 22, obtainable on request from the U. S. Bureau of Mines, Washington, D. C., describes the construction and use of the Universal and the Fireman's gas masks.

Mineral Resources — "Iron Ore, Pig Iron and Steel in 1921," pp. 32, a separate chapter of "Mineral Resources," is now available from the U. S. Geological Survey, Washington, D. C.

Recent Patents

Flotation Reagent — No. 1,448,929. March 20, 1923. Royer Luckenbach, Brooklyn, N. Y., assignor to Luckenbach Processes, Inc., San Francisco. A flotation reagent comprising the reaction product of a mixture of coal tar, coal tar creosote, a ketone, and caustic soda.

Cleaning Oil Wells—No. 1,448,997. March 20, 1923. Robert Foggan, Pleasantville, Pa. A method of cleaning the sediment from the walls of oil wells that have ceased to function as such.

Copper Leaching—English patent No. 190,246, Sept. 16, 1921, and Dec. 9, 1921. W. G. Perkins. According to *Chemistry and Industry*, crushed copper ores containing non-oxidized copper compounds (sulphides, arsenides, antimonides, etc.) are roasted at 350 to 700 deg. C. with access of air, so that copper sulphide is converted into copper sulphate with a corresponding swelling. The oxidized material is reduced by heating in a reducing atmosphere at 300 to 400 deg. C., and the resulting porous product leached, after cooling, with an ammoniacal solution of copper compounds in the presence of air or oxygen as described in English patent No. 185,242. Copper is recovered from the solution by expelling the ammonia. Where the dissolved copper-ammonium salt contains an acid radicle other than CO_3, a caustic alkali or carbonate is added in slight excess to the lye, either before or during the expulsion of ammonia, to precipitate the copper as oxide or carbonate.

Patent Index—The Index of Patents for 1922 is now available from the U. S. Patent Office, Washington, D. C. (pp. 1206). The names of patentees and the list of inventions are arranged alphabetically.

Electrolytic Copper — No. 1,449,462. March 27, 1923. G. D. van Arsdale, New York City. A process for dissolving and electrolytically precipitating cement copper.

Grinding Machine — No. 1,449,567. March 27, 1923. Oscar Wauthier, Brussels, Belgium. A variation of the swing-hammer pulverizer, in which the swinging hammers are pivoted on two steel plates mounted on a rotating shaft. The casing of the machine is lined with corrugated steel plates.

Flotation—No. 1,449,797. March 27, 1923. A. C. Vivian, Barnes, London, England. Oxidized metallic compounds are floated by first adding to the pulp amphoteric ("partly the one and partly the other; both acid and alkaline"—*Webster.*) compounds containing nitrogen and oxygen, which form a resinous decomposition product by chemical reaction with the oxidized mineral. This resinous product is amenable to flotation.

SOCIETIES, ADDRESSES, AND REPORTS

Zinc Institute Decides on National Campaign to Advertise Products

Operators Gathered in St. Louis Ask Co-operation of Galvanizers—F. C. Wallower, of Joplin, Succeeds E. H. Wolff as President —Fall Meeting To Be Held in Joplin-Miami District

BY P. R. COLDREN

A DEFINITE move toward the initiation of an extensive publicity campaign for zinc, and announcement that the galvanizers will be asked to co-operate with the other factors of the zinc industry were the outstanding features of the annual meeting of the American Zinc Institute, held at the Chase Hotel, in St. Louis, May 7 and 8. Ever since the Institute was first organized, five years ago, there have been discussions concerning the advisability of instituting a nation-wide publicity campaign for zinc, but nothing definite has heretofore been done. At this year's meeting, however, sentiment toward financing such a campaign was strong, and on the second day of the meeting the following resolution was unanimously adopted:

"Be it resolved: That the board of directors of the American Zinc Institute be instructed to perfect and execute a plan to raise and expend all of the moneys so raised in a sum not exceeding $100,000 for the purpose of conducting a national advertising campaign for zinc products for the coming year."

The board of directors will proceed at once to draw up plans for raising the specified sum on some sort of assessment basis in which ore producers, smelters, rollers, and finished zinc product makers will be asked to contribute.

The decision to ask the co-operation of galvanizers with the Institute was based on the belief that more united study of the situation will result in a largely increased popularity for the material and consequent increased use of zinc.

Frank C. Wallower, president of the Golden Rod Mining & Smelting Co., was selected as president of the Institute, succeeding E. H. Wolff, of the Illinois Zinc Co. Mr. Wallower is the first resident of Joplin, Mo., to be elected president of the Institute, and is also the first president not affiliated with the smelting side of the industry or with a rolling mill. C. T. Orr, the first president, was from Webb City, however, and is interested in the mining as well as the smelting department of the industry. Mr. Wolff has been president for three terms, and has been highly popular with the members of the organization, which has grown under his leadership. The present membership totals 192, representing every zinc mine of consequence, every zinc smelter, and every zinc rolling mill in the United States.

In his farewell address, Mr. Wolff called attention to some of the accomplishments of the Zinc Institute, particularly lauding the work of the development of industry committee, which has for its chairman Mr. George C. Stone. Although it has been handicapped by a shortage of funds, the committee, according to Mr. Wolff, has these accomplishments to its credit:

1. The completion and distribution of four architectural service sheets.
2. International standardization of zinc ore, slab zinc, and sheet zinc specifications.
3. Zinc Workers' Handbook, the main part of which is completed and awaiting a series of tests of corrugated zinc sheets and attachments now being conducted by the Bureau of Standards at Washington, under the auspices of the American Zinc Institute.
4. Investigation of refractories now in use by the smelters of zinc.
5. Participation in an effort to standardize the routine analysis of pigments.
6. Participation in the establishment of the Mississippi Valley Experiment Station of the Bureau of Mines, which is now functioning in behalf of the ore and slab-zinc producers.
7. Standardization of the practice of buying and selling of ore in the Tri-State district at the suggestion of the Institute.
8. Investigation of zinc for roofing for the special use of farmers by the Bureau of Mines.
9. Experimental zinc letter boxes are now being made for test by the Post Office Department.
10. A committee of ten appointed by the Institute during the last year to act as an advisory committee with the Bureau of Mines in the matter of co-operating with the industry in all of its branches.

W. R. Ingalls, of New York, spoke on Monday concerning the outlook for the zinc industry. He suggested that a large demand for export to Europe cannot be expected, and endorsed the effort to create among galvanizers more interest in the problem of increasing demand for zinc.

The first day's program also included the organization meeting of the American Zinc Institute National Advisory Committee, appointed to co-operate with the Bureau of Mines, on the mining, milling and metallurgical treatment of zinc ores.

The second day's session included a paper on "Budgeting for Business Control," by George F. Wolff, of the New Jersey Zinc Co.; an instructive article on zinc oxide and lithopone by Edward V. Peters, of the same company; a paper on zinc and, particularly, the zinc market, by C. S. Trench; an article on milling practices in the Tri-State field by Herbert H. Wallower; and a discussion of the ore-producing situation in the same field by Otto Ruhl, mining engineer of Joplin.

Vice-presidents of the Institute were selected for the coming year as follows: A. P. Cobb, of the New Jersey Zinc Co., Cornelius Kelly, of the Anaconda Copper Mining Co.; and Jesse G. Starr, of the Quinton Spelter Co. Howard I. Young was re-elected treasurer.

It was voted to have the next annual meeting in May in St. Louis and the mid-year meeting next fall in the Joplin-Miami district.

Society of Economic Geologists Meeting

The Society of Economic Geologists will hold its meeting Friday and Saturday, May 18 and 19, at the Engineering Societies Building, 29 West 39th St., New York City. Many papers on economic geology will be read at the technical sessions on both these days, which will begin in the mornings at 9:30 and in the afternoons at 2:00 o'clock. The address of the president of the society will be given at 2 p.m. Friday, May 18, at the same place. A smoker will be held at the Columbia Club Friday evening, and a dinner at the Harvard Club on Saturday evening. Geological and mining societies interested in economic geology and the graduate students of universities have been invited to the technical sessions.

The gold medal of the society, founded by the first president, Dr. R. A. F. Penrose, Jr., has been completed and will probably be exhibited at the dinner. Prof. J. F. Kemp, of Columbia University, will be toastmaster. The chairman of the Arrangements Committee is Frederick G. Clapp, of New York; of the Program Committee, Prof. Alan M. Bateman, of Yale University.

MEN YOU SHOULD KNOW ABOUT

Colonel A. P. Peake, of Butte, is in New York.

D. M. Liddell, of Weld & Liddell, was recently in Chicago on professional business.

Dr. Kuno B. Heberlein returned the latter part of April from a business trip in Europe.

Theodore W. Bouchelle has returned from Nicaragua and is temporarily in New York.

R. C. Warrener, president of the Colonial Mines, is visiting Cobalt and Kirkland Lake, Ontario.

Philip R. Bradley, manager of the Alaska Juneau mine, has returned from San Francisco to Treadwell.

Ralph Baverstock, of Los Angeles, was recently in the Magalia Ridge district in Butte County, Calif.

Robert J. Grant, superintendent of the Denver mint, was in San Francisco during the last week of April.

Fred. Searles, Jr., consulting geologist of San Francisco, has been in the Globe-Miami mining district during the last week.

A. G. Larsen, of Spokane, has arrived at Stewart, B. C., to supervise development work at the Virginia and Taurus groups.

J. W. Sherwin, general manager of the West End and Halifax companies at Tonopah, is in Tonopah from his Oakland headquarters.

J. K. Turner, mining engineer of Goldfield, Nev., has returned to Goldfield from an extended trip to Oatman and other Arizona points.

Forest Rutherford, consulting mining and metallurgical engineer, has moved his offices from 120 Broadway to 50 Broad St., New York City.

A. W. Newberry, mining engineer, of New York, is at Reno, Nev., where he is making an exhaustive examination of some precious-metal mines.

G. D. B. Turner, consulting engineer for Mobile Mines, Ltd., and Indian Mines, Ltd., has returned to Stewart, B. C., from eastern Canada.

J. A. P. Gibb, prominently identified with the mining interests of South Africa, is making a tour of the northern Ontario mining districts.

John G. Barry, mining geologist, has returned to El Paso, Tex., having completed some mine examination work at Sierra Mojada, Coahuila, Mexico.

B. W. W. McDougall has arrived at Stewart, B. C., from Colorado, and will superintend exploration at the Daly-Alaska mine, for H. S. Denny, of London.

Percy E. Barbour, of New York, assistant secretary, A.I.M.E., was recently in Wallace, Idaho, and spent several days in the Coeur d'Alene district.

Frederic R. Weekes is directing the development operations of the Comstock Merger Mines, Inc., and the Nevada Canyon Mining Corporation, at Virginia City, Nev.

E. P. Swenson, of New York, president of the Freeport Texas Co., was in Texas recently inspecting the operations of the Freeport Sulphur Co. at Freeport and Hoskins Mound.

C. A. Rose

C. A. Rose, previously connected with Guggenheim Bros. in an important capacity, has been appointed general manager of the British America Nickel Corporation, Ltd., with offices at Ottawa, Canada, and operations will begin at 100 per cent capacity immediately.

Ezequiel Ordoñez, geologist for the Pan-American Company, was recently in New York on his way to make examinations of promising petroleum fields in South America. Mr. Ordoñez was formerly in the Geological Survey of Mexico.

C. M. Weld, of Weld & Liddell, returned to New York recently from Michigan, where he had examined a group of iron mines. He left again on May 9 for West Virginia on a short professional engagement.

Thomas Cochran, of the firm of J. P. Morgan & Co., was elected a director of the Kennecott Copper Corporation at the annual meeting of stockholders on May 1. He succeeds Edmond A. Guggenheim, resigned.

General John C. Greenway, general manager, Calumet & Arizona; Carl I. Mohler, superintendent of the 85 Mine, at Lordsburg, N. M., and other directors are on a visit to the Erupcion lead properties in Chihuahua, Mexico.

George Lynch, of Los Angeles, has returned from the Copper Queen mill of the Phelps Dodge interests at Warren, Ariz., where he has designed the dust-collecting system, and leaves for the Moctezuma Copper Co.'s plant at Nacozari to install the Lynch dust-collecting system at that plant.

Edwin J. Collins, who has had a consulting engineering office in Duluth for the last fourteen years, has been elected a director and second vice-president of the Calumet & Arizona Mining Co. and the New Cornelia Copper Co. He will devote his time exclusively to the interests of those companies, with headquarters at Calumet, Mich.

J. B. Reeside and **C. E. Dobbin**, of the U. S. Geological Survey, are doing field work at Glendive, Mont. **L. W. Stephenson** and **C. W. Cooke** have been assigned to field work in Alabama. **Louis B. Kellum** will spend two months studying the stratigraphy and paleontology of the Eocene formation in North Carolina. **G. W. Stose** has resumed field work in Pennsylvania.

SOCIETY MEETINGS ANNOUNCED

The twenty-eighth annual meeting of the Northwest Mining Convention will be held at Spokane, Wash., May 22 to 25.

The twenty-third general meeting of the American Iron and Steel Institute will be held at the Hotel Commodore, New York City, on Friday, May 25.

OBITUARY

John M. Schnatterly, president of the Idaho Gold & Ruby Mining Co., was recently killed by an explosion aboard his yacht at Bonners Ferry, Idaho.

Henry M. Adkinson, for a number of years engaged in the practice of the mining profession in Utah and neighboring states, died at Salt Lake City on the evening of May 1, of endocarditis. Mr. Adkinson, who at the time of his death was president of the Interstate Mining & Milling Co., was also chairman of the Utah Section of the American Institute of Mining and Metallurgical Engineers and vice-chairman of the mining committee of the Salt Lake City Chamber of Commerce. Aside from his purely professional interests, Mr. Adkinson took an active interest in the affairs of the community, having been president of the Parent-Teachers' Association of the East High School of Salt Lake City and superintendent of the First Congregational Church Sunday School. Mr. Adkinson, who was forty-nine years old, was born in Chicago, and received his education at the University of Chicago.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

"INDEPENDENT" silver producers may tender metal for future delivery at Pittman Act price, after complying with conditions prescribed by supplementary regulations just promulgated by the Director of the Mint. Delivery of ore to any plant that "produces bullion" qualifies the contained silver for tender.

The Jardine Mining Co. has produced the first arsenious oxide from its new plant in Montana.

Phelps Dodge operations at Morenci, Ariz., will be accelerated as rapidly as men can be obtained.

Lake Superior iron-mining companies have raised wages by from 10 to 15 per cent.

The Homestake mine property in South Dakota is involved in a suit instituted against the United States by the Sioux Indian Nation.

A 70-ft shoot of 20 per cent copper ore has been opened by the U. V. X. company at Jerome, Ariz.

Quicksilver production is resumed at the New Idria mine in California.

The new mill of the Hilltop Nevada Mining Co. is ready to start at Battle Mountain.

A group of properties at Leadville, Colorado, will be reopened by the newly organized Leadville Deep Mining Co.

U. S. Supreme Court Upholds Minnesota Iron-Mine Tax

"Occupational Tax" Says Decision—$5,000,000 Back Payments Due State—Operations Are Not Interstate Commerce —No Discrimination Recognized

THE state law prescribing a tax of 6 per cent on the value of iron ore mined in Minnesota has been sustained by the United States Supreme Court in a decision handed down on May 7. About $5,000,000 in back taxes will be collectible under the decision from a large number of companies.

The mining companies contended that the act was invalid, as in conflict with the constitutional provision that "taxes shall be uniform on the same class of subjects"; and that the tax was a property tax instead of an occupation tax.

The recent decision says:

"We think the tax in its essence is what the act calls it—an occupation tax. It is not laid on the land containing the ore, nor on the ore after removal, but on the business of mining the ore, which consists in severing it from its natural bed and bringing it to the surface, where it can become an article of commerce and be utilized in the industrial arts. Mining is a well-recognized business, wherein capital and labor are extensively employed. This is particularly true in Minnesota. Obviously a tax laid on those who are engaged in that business, and laid on them solely because they are so engaged, as is the case here, is an occupation tax.

"The chief contention is that mining as conducted by the plaintiffs, if not actually a part of interstate commerce, is so closely connected therewith that to tax it is to burden or interfere with such commerce, which a state cannot do consistently with the commerce clause of the Constitution of the United States," said the court, explaining that the mining companies said practically all of their output was used outside the state and thus went at once into interstate commerce.

"Plainly the facts do not support the contention. Mining is not interstate commerce, but, like manufacturing, is a local business subject to local regulation and taxation.

"The contentions made under the equal protection provision of the Fourteenth Amendment and under the state constitutional provision that 'taxes shall be uniform upon the same class of subjects' present a question of classification and have been argued together. Consequently with both provisions the Legislature of the state may exercise a wide discretion in selecting the subjects of taxation, particularly as respects taxes."

One of these contentions was that the contractors who stripped the soil, and who loaded cars, or took ore out of the ground, were not included in the tax, but the court held that "none of these are engaged in mining on their own account," and that their pay was part of the expenses of the business they were working for.

Another objection was that some miners who did extensive development work but removed no ore were not included. The Supreme Court said:

"Equality does not require that unproductive mining be taxed along with productive mining. Besides, if ore is uncovered or made accessible by such development work the tax will be imposed when the ore is mined.

"Among the deductions which the act provides shall be made from the value of the ore before computing the tax is 'the amount of royalties paid on the ore mined and produced.' The provision is assailed as working a serious discrimination in favor of those who operate under leases and pay royalties, as all the lessees do, and against owners who operate their own mines and pay no royalties.

"It is also said that the royalty provision and others respecting deductions will work a discrimination as between different lessees, in that some will be subjected to a higher tax than others. No doubt there will be differences in the amount, but they will result from differences in situation and not from differences in treatment. . . .

"But all lessees will have the benefit of deductions adjusted to the royalties, expenses and taxes actually paid, and the value of the ore, according to the tax which will be computed, will, in each instance, be its actual value when it is brought out of the mine, less these deductions. In short, the tax is to be adjusted to the value of the output, less the major expenses of the business, and this according to uniform rule.

"We, therefore, cannot say that it is intended to, or will, work any arbitrary or unreasonable discrimination as between different lessees."

Colorado Mine-Labor Situation Has Become Serious

Work for 500 More Machine Miners—Bonus Scheme Found Helpful—How It Works

Special Correspondence

Colorado metal-mine operators are facing a serious shortage of labor, extending, so far as skilled labor is concerned, to practically every important mining district of the state. A recent survey of the labor conditions made by the Colorado Metal Mining Association indicates a shortage of machine men everywhere in the state, and that, in the aggregate, more than 500 more men could at once find employment in Colorado metal-mining operations if they were available.

The Colorado basic wage scale is $4.50 for machinemen and timbermen, $4 for muckers, and $3.50 for surface men. In several of the larger mines a bonus or contract system is employed, with satisfactory results. In reply to the questionnaire sent out by the Metal Mining Association, one of the largest operators in the state suggests that the bonus system be adopted as a relief measure. He says:

"During the past month, due to the general raise in wage scales throughout the country, more particularly in the copper operations, we have been confronted with a very serious problem, not only to keep the existing force intact but to increase forces with new men coming in. With the materially higher wages being offered in other states, and our relative isolation, there are very few men 'rustling.' Another point to be taken into consideration is that in the spring a large number of the regular miners leave for the farms or go out on road work, where the wages are practically equal to or greater than the regular mine wages.

"In order to overcome the above mentioned features, so as to permit maximum production, we have been forced to make certain modifications in the earnings of certain classes of labor, this being applied in the form of a bonus for work performed or for the number of continuous days worked during the month. This bonus averages around 50c. per day on machinemen, timbermen, and certain classes of labor on which there is a shortage. While, even with this bonus, the earning is still below the regular scale offered in many of the larger camps in other states, yet it has been sufficient inducement for many of our most experienced and regular workmen to remain with us, who otherwise were preparing to leave for the higher-pay localities.

"The general application of the bonus system has been most satisfactory, as it puts a premium on the labor of men who want to work, and who work steadily. The increased efficiency has more than offset the increase in cost; it has also created a better working spirit among the men than could have been obtained by a flat wage increase. Another advantage is that the bonus is flexible and can be modified according to working conditions, while with a fixed wage scale any modification is almost impossible, once it is established."

Hilltop Nevada Mill Ready to Start

The Hilltop Nevada Co., operating the Hilltop mine, near Battle Mountain, expects to make a raise connection between the transportation tunnel and the upper or Burns tunnel early in July. The principal developed ore is above the Burns tunnel, and this connection will place this ore available for the mill. Power plant and mill are ready to operate, and it is planned to start the mill about May 15.

"Step on It"—Orders to Morenci Branch by Phelps Dodge

800 Men Will Be Taken On as Fast as Obtainable—Copper Smelter to Start

The Phelps Dodge Corporation has issued instructions to officials at its Morenci branch to increase the scale of operations as fast as practicable. The plans for increasing the output will mean the employment of 800 more men in the company's mine, mill, and smelter. The No. 6 concentrator capacity will be increased to 4,500 tons per day, which is 500 tons in excess of the tonnage treated in that plant when it was operated by the Arizona Copper Co., the former owners of the Morenci properties. About 1,400 tons per day are now being treated by each section of the mill. Several months will be required to complete the installations and changes that will be necessary to prepare for handling the greater production. One unit of the smelter at Clifton is to be started soon, and the bins are being stocked with concentrates preparatory to the resumption. It is estimated that the initial production of this plant will be about 2,000,000 lb. per month, but this will be greatly increased when production, as called for by the new plans, get regularly under way.

Britishers Do the Digging in Ontario Mines

Few Americans—Italians and Finns Lead Foreigners

A report on the nationality of the workers in the leading mines in northern Ontario has recently been issued by the Ontario Mining Association. It shows that Canadian and British workers constitute 61 per cent of the total employed. The percentage of Americans, contrary to the general belief, is low and amounts to only 1.4 per cent. The bulk of the foreigners are Italians, Finns, and Poles, the Italians leading with 9.2 per cent. The percentage of Finns is 7.8 per cent, of Poles 7.5 per cent, Slavonians 4.2 per cent and of Austrians 4.3 per cent. This compilation effectually disposes of the claims of labor leaders that the big proportion of the workers were foreigners and will be of great assistance in enabling the different companies to offer inducements to more Cornish miners to migrate to Ontario.

Activity in Walker District, of Arizona, Grows

Reopening of Smelter at Humboldt Has Stimulated Operations—Sheldon Principle Producer

BY G. M. SPARKES

The operation of the smelter of the Southwest Metals Co. at Humboldt, Ariz., has added impetus to mining in the Walker district. The principle property operating is the Sheldon, which produced in January 260 oz. of gold, 10,000 oz. of silver, and 60,000 lb. of copper, according to smelter returns. At present shipments are being made of about 60 to 70 tons per day.

Development work is being pushed, especially on the north drifts on the 450 and 650 levels and in a winze from the 650, the bottom of which is entirely in shipping ore.

The Poland tunnel, which the Sheldon company purchased last July, is now operating, permitting a cost in January of $1.99 per ton of ore, covering the transportation from the shaft to the smelter. Development charges in January were $1.80 per ton of ore extracted.

The Black Diamond bondholders have secured a deed to their property, and according to reports they expect to resume operations in the early spring. Their proposed work includes further sinking of the shaft and considerable lateral development work.

The Express Mining Co., operating for the last eight months, shipped a carload of high-grade ore to El Paso from its property and is pushing additional development work.

Work on the Curran group is being done by Denver people; they intend to enlarge their operations soon.

The Blue John, under the supervision of J. H. Cavanaugh, has been operating through the winter and has considerable high-grade ore ready to ship to the smelter.

The Steuber & Anderson lease on the McLeod properties promises results soon. Several hundred tons of high-grade ore has been taken out on this property. Work on a new copper discovery is now being pushed.

Owners of the Bannie mine are now making preparations to resume work, and material for this is now being purchased.

Higher Wages for Lake Superior Iron Miners

All mining companies operating in Lake Superior region have increased wages by from 10 to 15 per cent, the new scale taking effect on May 1. The new wage for common labor is $4.20, compared to $3.75. It was almost certain that this action would result after an announcement was made that the 1923 iron-ore prices had been advanced 50c. a ton over the 1922 rates. Men working on lake freighters have also been given an increase in wages, the new scale being about 10 per cent higher than that of last season.

Leadville Deep Mining Co. Will Open Group of Properties

Electric Pumps to Unwater Workings—A. S. & R. and Iron Silver Interests Finance Project

The latest and most important new enterprise to be undertaken in the Leadville district in Colorado is the organization of the Leadville Deep Mining Co., formed for the purpose of unwatering and working a large area in and about the Graham Park Basin. Through ownership, leases, and working agreements, the company has acquired a group of properties among which are the Wolftone, Pyrenees, Mikado, Greenback, and Iron Silver holdings, which are to be unwatered and worked by the new company. The company has been organized with a capital of $500,000, and is jointly financed by the Iron Silver and the American Smelting & Refining interests.

The unwatering of the properties will, it is estimated, require about eight months' pumping, which will be undertaken from two shafts, one on the Pyrenees and the other on the Wolftone, where electrically driven pumps, each with a capacity of 2,000 gal. per minute, will be installed. The power, 1,600 hp., required to operate the pumps, will be furnished by the Colorado Power Co. The deepest workings on the properties are something over 1,300 ft. The latest and most modern mine equipment will be installed on the property as soon as it can be procured. Delivery of the pumps is expected about July first.

The consolidation was brought about by George O. Argall, general manager of the Iron Silver, who will have charge of operations for the new company, embracing the largest drainage project ever undertaken in the Leadville district. It will result in the unwatering of an area comprising a group of old-time bonanza producers, which made millions for their owners, and made Leadville famous. The properties are not in the class of "has-beens," but were closed down after the war on account of the unfavorable conditions which followed. The ore values are chiefly in zinc, lead, and silver.

Electrolytic Zinc Process Co. Incorporated at Butte

Articles of incorporation were recently filed by the Electrolytic Zinc Process Co. to "conduct a general mercantile, commercial, chemical or metallurgical business." The principal office of the company is at Butte. The capital stock of $10,000 is divided into shares of $100 each. The directors of the company are C. F. Kelly, of Butte; B. B. Thayer, of New York; James J. Warren, of Montreal, and Selwyn G. Blaylock, of Trail, B. C. The incorporators are L. O. Evans, Frederick Laist, and S. W. Blaylock. Blaylock and Warren are officials of the Consolidated Mining & Smelting Co. of Canada, which operates an electrolytic zinc plant at Trail. The others are Anaconda Copper company men.

New Idria Resumed Output of Quicksilver on April 25

The New Idria Quicksilver Mines Co. commenced production at its mines in California on April 25. The property has been kept in excellent condition during the receivership. Since the fire, which occurred in June, 1920, the plant has been gradually reconstructed, but certain installations, such as conveyor belts, transmission belts, and some alterations for more economical operation, have only recently been completed.

One rotary furnace is now in operation. Other furnaces will be started as soon as conditions warrant. The most difficult problem today is a shortage of labor.

Homestake Mine Involved in $700,000,000 Suit by Sioux Indians

Federal Government Defendant—Title of Present Owners Not Jeopardized

The Black Hills gold mining district of South Dakota is the most valuable part of 8,000,000 acres of land that is involved in a suit for $700,000,000 started by the Sioux Indian Nation against the United States. The Homestake mine, in this region, has a production record of $180,000,000 in gold and various other mines bring the total output to date to considerably more. The assured life of the property is many years, so that the gross production will be much more. According to the New York *World*, the Indians claim that the land in question was taken from them in 1875, "in violation of their rights and without just compensation being paid them."

Through their attorneys, they claim an accounting among other things for lands taken over from them under treaties, for which they have not been fully paid.

The claims hinge on treaties dating as far back as 1825 and call for a flat payment of $219,635,149.62, the compounded interest and collateral claims, bringing the sum up to $700,000,000.

The Indians do not ask for restitution of the property, so the titles now held by white men will not be jeopardized by the action.

They maintain that the mineral lands taken from them should be paid for at the rate of $100 an acre and that the timber land should be settled on a basis of $50 an acre. It is asserted the Black Hills forest reserve, containing one of the finest stands of white pine in the country, is worth more today than the entire sum asked for.

Still another demand, according to the *World*. is payment for big game killed by the whites on their hunting ground and for wood and hay cut by the military forces of the United States on their reservations. They insist upon a further accounting for lands opened for settlement under acts of Congress, providing that the proceeds shall be deposited to the credit of the Sioux Nation.

Operators Busy in Portland Canal District

Indian Mines Gets New Equipment—Premier Extension Has Started Work

There has been much activity in the Portland Canal district of British Columbia during the last few weeks, all the operators being anxious to utilize the last of the snow for moving supplies into the mines, before the weather breaks and the roads become little better than quagmires. Indian Mines has been particularly busy, about 135 tons of freight, including a compressor and sections of a 15,000-ton oil tank, having been moved to the mine. This work, however, has not been allowed to interfere with the driving of No. 1 and No. 3 tunnels. No. 1 tunnel is now in 400 ft. and No. 3 tunnel 220 ft. Both tunnels have been driven in ore for the full distance, gold being the predominating value in the lower tunnel and silver in the upper. Some rich gold ore, running up to 7 oz. per ton, has been found in the lower tunnel, but the average for the distance driven is about $25 per ton in gold and silver. A compressor is being erected at the mouth of No. 3 tunnel, and should be in operation within a week.

About twenty tons of ore, averaging 300 oz. per ton in silver, has been taken from the No. 1 tunnel by Mobile Mines, Ltd. The No. 2 tunnel is now approaching the oreshoot, and if it is in its normal position should cut it in another 15 to 20 ft. of driving. The property is on Glacier Creek, a tributary to Bear River.

The Premier Extension Gold Mining Co., Ltd., has been incorporated under Dominion Government charter to take over and operate the Woodbine-Kitchener group, adjoining the Premier Gold Mining Co.'s property. The company is capitalized at $4,000,000 in $5 shares, half of which are to remain in the treasury for the time being. It has been organized by prominent New York, London, Toronto, and San Francisco capitalists, J. J. Cone, of New York, being president, and Robert W. Hunt & Co., of Vancouver, consulting engineers. The property has been acquired from Hugh B. McGuire, who has spent the last two seasons opening it up for inspection. Work on buildings for a camp has been started.

R. R. Wilson, manager for the Trites, Wood & Wilson interests, has returned to Stewart to commence operations on the properties that the syndicate has under bond. These include the Big Missouri, Unicorn, International, and Stoner groups.

Calumet & Hecla Capital Multiplied by Eight

The Calumet & Hecla Mining Co. of Michigan has announced its intention to increase its capital stock to $20,000,000 and the number of shares to 800,000, or just eight times the present capitalization. A special meeting of the stockholders is called for June 4 at Boston, Mass., to act on this proposal.

New York Engineers Have Till Aug. 1 to Get License

Engineers in New York State will have until Aug. 1, 1923, to obtain licenses to practice in accordance with the New York License Law. It was shown that it would be impracticable to examine applications properly in the prescribed time, and the Legislature accordingly passed Senate Bill 2120, extending the time limit. The Governor signed the measure on May 4.

U.V.X. Has 70 Ft. of 20 Per Cent Copper Ore

Reports of a strike of importance at the United Verde Extension mine at Jerome, Ariz., as first given out by newspapers, were denied by President Douglas, who stated at that time that only small amounts of ore had been encountered in the floor of a drift on the 800 level, and that reports were exaggerated. However, the continuation of this development has opened an orebody that is proving to be important. The drift has been advanced 70 ft. beyond the point where ore was first found in the floor of the working, and the greater part of this distance has been entirely in cuprite and chalcocite ore that will average above 20 per cent copper and carries a good content of gold and silver. Drifting is being done on the east wall of the vein, but it is thought that the west wall is close. The find is at a point about 120 ft. east of the north and south fault, and it is believed that the broken nature of the vein is due to its proximity to the fault zone. It is evident that this development is near the top of the oreshoot, and its nature below must be guessed.

Construction Contracts Let by Columbia Steel in Utah

The Columbia Steel Corporation, organized to develop the iron-ore deposits of southern Utah, and intending to construct a steel plant in Utah, on the shores of Utah Lake between Provo and Springville, in Utah County, about 50 miles from Salt Lake City, has filed a mortgage to the Mercantile Trust Co. of California, trustee, to secure payment of an authorized issue of $10,000,000 first-mortgage gold bonds with the county recorder of Utah County. The Steel company has awarded contract to the Lynch Cannon Engineering Co., of Salt Lake, for laying the foundations for blast furnaces and stoves at Ironton (which is to be the name of the furnace site), and a contract to P. J. Moran, of Salt Lake City, for the installation of sewage and drainage system.

Mount Morgan Will Operate Ajax Copper Mine

By Cable from Reuters to "Engineering and Mining Journal-Press"

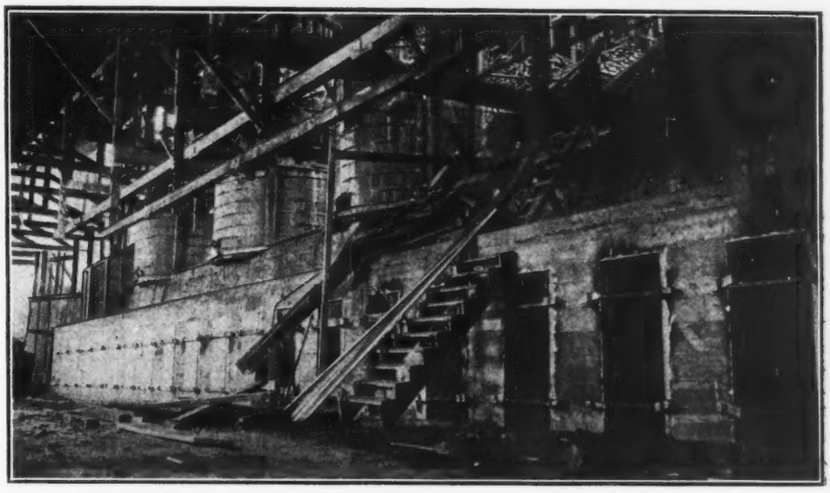
Brisbane, May 2.—The Mount Morgan Co. has acquired the Ajax Copper mine on an eight to twelve months' lease, with the right to purchase at the end of that period.

Jardine Mining Co. Makes Arsenious Oxide

New Plant Treats Gold-Bearing Concentrate at the Mine in Montana —Output Sold at 14½c. per Pound f.o.b. New Jersey

Special Correspondence

ON APRIL 15 the Jardine Mining Co. removed 75 tons of crude oxide of arsenic from the kitchens of its newly built plant at Jardine, Mont. This was the first product from the plant, which had been in operation for about thirty days. The mines of the Jardine company are on the edge of Yellowstone National Park, 6 miles from Gardiner, the nearest railroad point. They have been worked for gold for many years. The ore is low grade, however, and the recent demand for arsenic offered a welcome opportunity to realize from the large content of arsenopyrite that the gold ores contain.



Arsenic kitchens built in the old cyanide plant at the Jardine mine

A hydro-electric power plant of 350 hp. is now operating, but it is planned to increase this capacity by the installation of an additional 6-ft. Doble wheel and generator. There is a fall of 860 ft. between the ditch and the power plant.

The country rock is a quartz-mica schist. It has been subjected to great stresses, and as a result has many parallel fractures. The mineral veins were formed by the replacement of the schists along these fractures. The result has been some continuous veins several hundred feet in length that vary in width from 2 to 35 ft. Where veins are wider than 15 ft. horses of schist are usually found. The quartz in the vein is usually accompanied by a varying amount of arsenopyrite. In some of the smaller arsenopyrite veins little quartz is found. Scheelite occurs in some of the quartz veins and has been mined in commercial quantities. The property has been developed by twelve crosscut tunnels and drifts driven into the side of the mountain at different elevations. These have exposed six distinct veins upon which drifting has been done. The drifts vary in length from a few feet to five hundred. Little development work has been done by raising. According to reports of different engineers, 100,000 tons of arsenopyrite ore is available at this time that will average $7.50 in gold and 5 per cent arsenic.

The gold in the ore is recovered in a modern mill by amalgamation, fine grinding, and flotation. At the present time the mill is treating 150 tons per day. The recovery made by amalgamation is $2 per ton. The total mill recovery is said to be 85 per cent. The mill heads are averaging $7.50 in gold and 5 per cent arsenic. The concentrate which is now treated for arsenic formerly was shipped directly to the smelter at East Helena, Mont., or to Tacoma, Wash., and the company was penalized for the high arsenic content. As a consequence of the high price of arsenic, plans were made in December, 1922, to treat the concentrate and recover the arsenic at the mill. The average price of white arsenic for the last few years has been around 9c. per pound. At the present time it is quoted at 14¼c. Fortunately, the large mill building formerly used as a cyanide plant was in good condition. A few tanks were removed, the building was remodeled, and the new equipment was rapidly installed. A reverberatory furnace, connected with a dust chamber and a series of kitchens 6 x 8 ft. in section and 180 ft. long, were built. These were connected to a large stack, the top of which is 250 ft. higher than the furnace. Construction work was finished and the plant was operating on March 17, just two months from time it was started. The cost of plant, including building alteration and equipment, was $12 000.

The first time the concentrates are treated the reverberatory furnace is fired with ordinary mine-run coal. The

arsenic volatilizes and the fume is conducted through the dust chamber and thence to the baffled kitchens, where the arsenious oxide is deposited. This product is not white; accordingly it is stored until enough has been accumulated for refining. It is then put through the same process except that a coke fire is used in the reverberatory instead of a coal fire.

The concentrate as received from the mill averages 38 per cent arsenic and contains from 2 to 3 oz. in gold per ton. At the present time the capacity of the arsenic plant is limited to 100 tons of oxide per month.

The first car of calcined concentrates was shipped from Gardiner on March 29 to the East Helena smelter. The first shipment of refined white arsenic has been contracted for by W. F. B. Berger, who represents the Chipman Chemical Engineering Co. The price agreed on was 14½c. per pound f.o.b. Bound Brook, N. J.

Credit is due to H. C. Bacorn, manager; Charles Wraith, consulting engineer on arsenic operations; H. D. Morse, superintendent, and J. B. McKillican, mill superintendent, for the rapidity and success attained in this pioneer work in the production of arsenic in a small plant. The smelting companies have been producing arsenic oxide as a byproduct for years, but this is probably the first venture at producing it as a commercial enterprize in an "independent" plant.

News from Washington

By PAUL WOOTON
Special Correspondent

"Independent" Producers Can Tender Silver for Future Delivery

Arrival of Ore at Any Plant "That Produces Bullion" Qualifies Contained Metal—Officials Promulgate Further Regulations

SUPPLEMENTAL REGULATIONS governing the sales of silver under the Pittman Act have been drawn up by the Director of the Mint and promulgated by the Under Secretary of the Treasury. In issuing these supplementary regulations, attention was called to the fact that the existing regulations remain in full force and effect. The supplemental regulations follow in full:

"1. All silver salable to the Director of the Mint under the terms of the Act and the regulations prescribed thereunder shall be deemed to be tenderable to the Director of the Mint upon its receipt ready for reduction at a plant which produces bullion. No silver contained in tailings, slag, or mine dumps shall be tendered or accepted. No silver in any ore or concentrate not yet arrived at a plant which produces bullion shall be tendered or accepted.

"2. Tenders of refined silver for *future* delivery may be made only by telegram to the Director of the Mint, Washington, D. C., up to 1 p.m. each day for receipts at reduction works through the previous day, and must specifically state that they include all silver salable to the mint as domestic silver which has been received at the reduction works of the vendor, in the order in which the lots were received.

"3. Purchases of silver contained in doré bullion may be made upon delivery at the Philadelphia, San Francisco and Denver mints as heretofore.

"4. Tenders of silver contained in doré bullion for *future* delivery may be made only by telegram to the Director of the Mint, Washington, D. C., up to 1 p.m. each day for receipts at reduction works through the previous day, in the approximate recoverable quantity contained in the material upon which the tender is based, and must specifically state that the silver-bearing material has arrived at the plant on a specified date, and that the silver contained in the material is for future delivery and offered in the order in which the lots were received. Before any such tenders may be made for future delivery, of silver contained in doré bullion, the prospective vendor shall file with the Director of the Mint sworn abstracts from his books of account showing the quantity of silver on hand at his reduction works as of the close of business Dec. 31, 1922, scheduled as to production source (name of mine and state); together with sworn abstracts from his books of account for the quarter ended March 31, 1923, showing receipts scheduled by sources, production of bullion, deliveries scheduled by consignees, losses, and balance on hand. Similar monthly abstracts will be required to such date as final deliveries of silver tendered under the Act shall have been made. These abstracts shall form a continuous record of receipts, deliveries, and balances for the entire period covered, as provided by existing regulations.

"5. All silver delivered to the Director of the Mint must be covered by the usual affidavits showing that settlement for silver in the quantity specified has been made with the miner on the basis of not less than $1 per ounce, adjusted to the equivalent price for silver 999 fine and to the cost of delivery refinery to mint, as provided in existing regulations. Affidavits showing only provisional settlements with the miners will not be acceptable. Deliveries to the mints upon all accepted tenders must be made on or before Oct. 1, 1924.

"6. When the quantity of silver remaining purchasable by the government under the Act has been reduced to 10,000,000 oz., the Director of the Mint will make public announcement to that effect in order that daily tenders may be made of salable quantities received at reduction works. The total daily acceptances will be publicly announced by the Director of the Mint at 3 p.m. the same day, or as soon thereafter as practicable.

"7. The Director of the Mint reserves the right to inspect the books of account of any vendor for the purpose of determining whether or not all silver tenders and deliveries are in compliance with the regulations.

"8. Except as herein modified, the regulations governing the purchases of silver under the Pittman Act, issued under date of Aug. 30, 1920, as amended Oct. 6, 1920, and Dec. 2, 1921, continue in full force and effect."

These supplemental regulations were issued following representations by Senator Oddie, Senator Pittman, and Henry M. Rives on behalf of the producers of doré bullion, and in an effort to secure for the small producers the advantages of the same method of tenure allowed the smelters.

Senator Tasker L. Oddie, chairman of the Senate Commission of Gold and Silver Inquiry, after having listened to the defence of the Treasury Department's course in the matter of silver purchases under the Pittman Act, is convinced that the course of the department cannot be justified. It is his personal opinion that the department's moral obligation, at least, to the producers of silver has been overlooked. He also believes that the department will not be able to sustain its legal position. He expresses surprise that the department should continue to insist on a course which means serious injury to a vital industry. It is recognized, however, that the case in behalf of the silver producers must be built up carefully, and with that end in view, the commission has adopted the following formal resolution:

"Resolved, that Senator Pittman, as the author of the Pittman Act, and in view of his familiarity with the entire silver question, be appointed a subcommittee of one to make such investigations as he may deem necessary regarding the operation of that act generally and its administration by the Treasury Department, and to exercise all the powers of the commission pertinent thereto."

Bill for Alaskan Mine Development Board Defeated

The Alaska Legislature has taken action which will permit the territorial government to co-operate with the Bureau of Mines in the maintenance of a mine-inspection system. Under this arrangement B. D. Stewart will be mine inspector for the territory and supervising mining engineer for the Bureau of Mines, as well as the representative of the Secretary of the Interior in matters pertaining to leasing. The proposal to establish an Alaska Mining Development Board was defeated by one vote. The purpose of this board was to devise means whereby the mineral development of the territory could be stimulated. The bill carried an appropriation of $40,000 to defray expenses.

New W. M. R. Commissioner Makes Good Start

Sanctions Awards Refused by Former Commission—Reimburses for Construction of Railroad

An additional award of $58,982.86 has been recommended by John Briar, recently appointed War Minerals Relief Commissioner, in the claim of the Stange Mining Co. which prepared during the war to produce manganese in a large way in Virginia. This company received $95,633.04 under an award on the same claim from the former commission.

The largest single item allowed in the new recommendation is that covering an obligation to the Bland Lumber Co. This company secured the right of way and constructed a narrow-gage railroad for the transportation of the claimant's ore. The arrangement for the transportation of the ore is perfectly proper, Commissioner Briar holds. He points out that the claimant was preparing for large production "and the plan to build the narrow-gage road appears to have been within reason as to cost and highly satisfactory with respect to the rapid movement of the ore."

The three claims of Holbrook and McGuire, of San Francisco, were merged, and an award of $12,130.42 has been recommended. In one of the claims covering a manganese operation, the former commission held that the operation was non-commercial and denied the claim. "The government engineer," says Mr. Briar's opinion in connection with the manganese claim, "reports that a very satisfactory orebody was disclosed, but that the silica content was too high to permit of marketing unless the ore be hand sorted, the cost of which appeared to be prohibitive. The record shows that when W. C. Phalen, of the Bureau of Mines, visited the property he stated that the ore was worth concentrating by hand sorting and urged them, owing to the government need of manganese, to go ahead. This would seem to estop the government from claiming now that the mine was non-commercial."

Other recommendations, subject to the approval of the Secretary of the Interior, have been made as follows: Grasselli Chemical Co., Cleveland, Ohio, $44,244.05; Matchless Tungsten Mining Co., Denver, $4,367.94; Blair and Newmyer, Boulder, Colo., $3,331.14; I. M. Furlong, Denver, $2,924.81; J. W. Ball, Oakdale, Calif., $454.79; Robert W. Weldon, Watts Valley, Calif., $241; Lee Gray, Colfax, Calif., $123.60; Bert Hammel, Fresno, Calif., $400; A. A. Blassingame, Fresno, $185.

Pittman Act Purchases

Purchases of silver by the Bureau of the Mint during the week ended May 5 amounted to 1,107,000 oz. This brings the total purchases (including tenders for future delivery) under the Pittman Act to 184,034,584 fine ounces.

News by Mining Districts

By Special Correspondents in the Field

London Letter

Nundydroog Profit Declines—London Sees "Devious" Motives Behind Premier Report

BY W. A. DOMAN

London, April 26—A larger tonnage of ore was crushed at the Nundydroog, Mine (India) in 1922 than in 1921 (115,092 tons against 105,682) for approximately 100 oz. more of gold. As, however, the metal, sold locally, fetched 11s. 10d. less, the value was only £295,164, in contrast with £334,022. The profit fell from £105,421 to £68,319. Economy seems to have been practiced in various directions, for although 9,410 tons of quartz and 38,215 tons of slimes more were dealt with, the average cost per ton was 35s. 8d. against 39s. The enlarged tonnage helped in this respect, but there was an increase of 2,675 ft. in development and much expense was incurred in cutting the chambers for the main winze electric hoists and the 4,000-level pumping plant.

The royalty of 4s. per ton payable in respect of ore taken from the Tank Block has been compounded for £12,000. At various deep points, ore of good gold content has been met with, though widths in places are rather narrow. Development measured 12,475 ft. and opened up 131,192 tons of ore, thus increasing the reserves from 175,200 tons to 191,300 tons. The prospects of the mine have been greatly enhanced by the large measure of success which has attended the underground developments during the year. Expenditure at the Henry Shaft, £26,488, was entirely written off out of profits.

The annual report of the Waihi Gold Mining Co., of New Zealand, for 1922 is, as usual, one of the most informative of such documents published. Full details of development and metallurgical work are given, so that it is possible to follow the work in all its stages. As against 181,092 dry tons crushed, mainly from the Martha lode (eighteen shoots in all are worked) no less than 222,030 new tons was opened up. The total in the mine is 708,808 tons, of an average assay value (gold at 84s.) of 33.61s. Total revenue was £325,176, a reduction of £60,088, due to the fall in the price of gold and the sale of investments in the previous year to make a return of capital of 10s. per share. In dividends, 20 per cent was paid, and £11,048 goes forward. Development and dead work amounted to 15,463 ft., costing £32,667. The financial position remains remarkably strong. The book value of the Hora-Hora Hydro Electric Works, sold to the New Zealand Government for £212,500, receivable in 1931, is £159,535. The government supplied power to the value of £10,625.

The annual report of the Premier Gold Mines, British Columbia, has reached this side. It created a feeling of disappointment. The view generally expressed is that the document has been made unduly depressing for control purposes. And not only so, but there is said to be a desire to depreciate the whole district in order that certain parties may acquire areas at more reasonable prices than would otherwise be possible. Many propositions are being brought to this side, but the flamboyant circulars are choking the public off.

San Francisco Letter

Argonaut and Kennedy Connection Will Be Maintained—Mariposa County News

Special Correspondence

San Francisco, April 30—The Industrial Accident Commission of California held a hearing on April 24, in San Francisco, at which the commission presented its evidence bearing upon a proposed order to make the connection between the Argonaut and Kennedy mines on the 3,600 level of the latter and the 4,200 level of the former, which was driven at the time of the Argonaut disaster, a permanent connection between the two mines to be properly protected by doors and maintained in usable condition. The hearing was amicable. It appears that the principal mining work in the Kennedy at present is upon the 4,050, 3,900 and 3,700 levels. Some work is being done upon the 3,600 level, and the main Kennedy shaft is being sunk to command a new level. About 150 men are employed underground. The second exit is equipped with a hoist that serves the mine to the 2,400 level and connects with raises extending to the bottom level.

The Argonaut will operate from the 4,200 to 4,800 levels inclusive when it succeeds in unwatering its main shaft. Its exit, the Muldoon shaft, is equipped with a hoist to the 800 ft. level, and below this a system of staggered raises connects with the levels.

Questions were asked F. L. Lowell, one of the mine inspectors, as to the time that would be required for men to climb out of the Argonaut, but the estimates were vague. Various documents were submitted by the commission. The hearing came to an end when William E. Colby, attorney for the Kennedy Mining & Milling Co., agreed to the maintenance of the existing 3,600-4,200 level connection between both mines, without, however, waiving any rights by reason of the voluntary arrangement. The working out of the expense question and the structural details of the connection was left with the superintendents of both properties and F. L. Lowell, mining engineer of the commission, their report to be made in the near future.

The Virginia mine, operated by the Virginia-Belmont Mining Co., has been abandoned and the pumps have been drawn. The Virginia is one of the few

mines in Mariposa County that has operated more or less continuously for several years. The Mountain King mine was shut down a year or more ago. The Original mine, at Clearing House, on the Merced River & Yosemite Valley R.R., is and has been operating a 10-stamp mill continuously for several years. W. A. Deaner is installing a 10-stamp mill at the Queen Specimen mine, adjoining the Pine Tree mine of the Mariposa Grant. A new shaft is being sunk on the Princeton mine by the Princeton Gold Mining Co., of Los Angeles. T. E. Kelso is in charge of the operations, and has sunk the new shaft to a depth of 225 ft. A 1,660-ft. shaft was at one time on the Princeton, and ore was stoped from the 1,200 level to the surface. A considerable production was made long ago. The present operations are for the purpose of prospecting the vein for new oreshoots. The old Mariposa mine at Mariposa is being cleaned out preparatory to prospecting. H. H. Carpenter and associates have erected a new headframe and installed an electric hoist and are cleaning out the incline shaft.

C. D. Jones, of Los Angeles, is reported to have obtained an option on the Reid, Evening Star, and Central gold mines, all adjoining, at Old Diggins, Shasta County. The Reid supplied low-grade siliceous gold ores to the smelters at Kennett and Bully Hill, but when the smelters shut down mining operations were discontinued. The present plans contemplate treating the ore in a mill which is to be constructed. Harvey Sallee is cleaning out the Texas mine preliminary to beginning development work.

BRITISH COLUMBIA

Providence Mine Goes to Bondholders

The Providence mine, at Greenwood, was recently sold at sheriff sale for $2,000, subject to a bond issue of $50,000. The purchaser was William Madden, of Chicago, backed by the principal bondholders. The Providence mine was one of the principal gold-silver mines of the district, and an offer of $1,000,000 was refused by the owners twenty years ago. The new owners will resume operations on an extensive scale, according to reports coming from Greenwood.

Consolidated M. & S. Talks Dividends

At the annual meeting of the Consolidated Mining & Smelting Co., in which the Canadian Pacific is heavily interested, hopes of dividend prospects were discussed. No definite promises at this time are held, it being the policy of the company to be conservative. In the last ten years average returns on shares has been 6.96 per cent per year, despite the fact that no dividends have been declared recently. The stockholders confirmed a bond issue of $7,500,000 authorized May 30, 1922, and passed a by-law authorizing the company to guarantee an issue up to $2,000,000 on West Kootenai Power bonds.

ONTARIO

Vipond Oreshoot Develops Well

Officials of the Vipond property, in the Porcupine district of Ontario, are feeling optimistic regarding the future of that mine, and there is a strong possibility that it will be the next producer in the Porcupine district. Recent work on the 400 level has resulted in the discovery of a new vein carrying much higher values than the general average of the mine. Where intercepted, the vein assayed $20 across the width of the drift, and has been driven on for a length of 180 ft., with a width of from 5 to 12 ft. Crosscuts are now being driven on the 300 and 500 levels to cut the same orebody, and if similar values are found on these levels it is expected that the mill will be started soon. The property is equipped with a mill of approximately 100 tons a day, but has not been in operation for several years, as the grade of the other orebodies on the property is not high enough to do little more than pay expenses.

YUKON TERRITORY

9,000 Tons of 250 Oz. Silver Ore Awaits Boats at Mayo

The fleet of four river steamers, with their numerous ore barges, are being overhauled at Dawson, ready for the opening of navigation, which is expected early this year. Approximately 9,000 tons of ore is at Mayo Landing, ready for transportation. It is said that the ore will average close to 250 oz. of silver per ton. Sam Thurber and associates have been developing a new vein on Keno Hill during the winter, the tenor of which ranges from $40 to $240 per ton in silver and lead over an average width of 23 ft. Much of this ore, of course, will have to be concentrated before it is shipped, as, owing to the long haul by land and water and the changing from one form of conveyance to another, it is not profitable to ship ore running much below $125 per ton.

MEXICO

Penasco Blanco Group Will Be Developed

Fred O. Bostnick, of Douglas, Ariz., has increased his operations in the Yecora region by taking over the Penasco Blanco group of gold-silver properties. The old workings are to be cleaned out and development work is to be done by carrying them to a greater depth.

William Wilkins Acquires Claims

The Buena Vista group of mines, situated in the Cejita Mountains, Morelos district, State of Chihuahua, has been acquired by William Wilkins, of El Paso, Tex. The group comprises fifty pertenencias, which are traversed by several promising veins. The new owner plans to prospect the ground thoroughly before outlining a plan of development to be followed.

New Ground for Ventura

The Ventura Mining Co., through its attorney, Agustin Aguilar, has filed on some additional claims in the Arizpe district in Sonora. The new properties are near the Meteoro, La Ventura, La Gilondrina, and Maria mines, and will be titled as the Espiritu Santo group.

ARIZONA

Minority Stockholders Win

Litigation involved in the sale of the Seventy Nine mine, of the Winkleman district, has been decided in favor of the plaintiff, Thomas A. Harrison and minority stockholders of the Continental Commission Co. The decision orders that the Seventy Nine company repay the amount that had been advanced by T. D. Love and that the property be reconveyed to the Continental Commission Co.

Three Killed in Southwest Mine

Three men were killed in a cave that occurred in a stope of the Southwest mine of the Bisbee district, April 24. The property is operated by Reese and Yutich, leasors, neither of whom was at the mine at the time of the accident. A fourth man was seriously injured by the falling rock, but will recover. The four men had just begun work in a stope about 30 ft. above the 300 level, when large boulders from above crashed down upon them.

Katherine Grades for Mill

The Katherine Mining Co., operating near Kingman, has asked for bids on machinery for a new 300-ton mill for the company's mine. A 150-ton crusher, three 250 hp. Diesel engines to operate electric generators, tanks, and other equipment will be required. Grading for the mill has been started, according to recent reports.

IDAHO

Federal M. & S. Co. Bonds Minnie Moore Mine

An important transaction in the Wood River mining region is the taking over on option of the Minnie Moore mine, a half mile west of Bellevue, by the Federal Mining & Smelting Co.

The consummation of the transaction has been pending for some time between I. E. Rockwell, president and general manager of the mine, and officials of the Federal company, which is now operating the North Star and Independence mines, twelve miles north of Hailey. The work of unwatering the property, which has lain idle for the past fifteen years, will start soon. The property comprises twenty claims.

The Minnie Moore has produced between $8,000,000 and $10,000,000 worth of galena ore. The Wood River Power Co. is to make sufficient additions to the capacity of its power line between Malad and Shoshone to supply all the increased demands that may be made by the opening up again of the Minnie property.

NEVADA

Mill for Searchlight

W. C. Tracey is remodeling the old mill of the Duplex Mining Co. at Searchlight. He is installing two 50-hp. semi-Diesel engines and one 40-hp. generator. The first will contain a 70-ton Herman ball mill. Later an additional 70-ton unit is planned. This is for a leaching plant, in which it is planned to treat ore from the Duplex mine and also custom ores from the district.

Comstock Merger Development Looks Good

The Comstock Merger Mines Co. has a force of 250 men at work on that part of the Comstock Lode included in the Hale & Norcross, Savage, Gould & Curry, and Chollar and Potosi ground. No definite statement has been made, but rumor has it that results are favorable, that another substantial payment will soon be made, and that, if results in the next few months are as satisfactory as in the past, mill construction will begin by the first of July. There appears to be no immediate intention to start the lower tunnel, survey of which was completed some time ago, and it is rumored that the company may take in the North-End mines in the consolidation.

Tonopah Mills Work at Capacity

That the mining companies in Tonopah are taking advantage of the silver situation is evidenced by the fact that there is at present only one mill which can take custom ore. The Tonopah Mining Co. discontinued taking any but its own ore on May 1, and the Belmont is working to capacity on its own and some custom ore. The West End is shipping 50 tons per day to the Belmont, in addition to supplying its own 260-ton mill to capacity. The Halifax is shipping 40 tons of ore per day, and if recent developments on the 1,000 level continue to improve, shipments will undoubtedly be increased. The Tonopah Extension is the largest individual producer in camp, and is reported to have the largest ore reserves of any mine in the district. Shortage of skilled miners has interfered with extensive development plans in several of the Tonopah properties, but ore production continues without interruption.

MONTANA

Jib Consolidated Is Tearing Down Old Mill at Basin

At a recent meeting of the Jib Consolidated Mining Co. the following officers were elected: Robert W. Shingle, of Honolulu, president; John MacGinniss, of New York, vice-president; James F. Peck, of San Francisco, vice-president and general counsel; B. F. Edwards, of Oakland, treasurer; and F. C. Pringle, of New York, secretary. W. L. Creeden, of Butte, has been made general manager. This company has an interest in the Jib, Hope, Katie and other old-time producing properties, all of which are in the Basin district.

Considerable development work has been carried on in the past six months, and a large tonnage of ore has been blocked out. Plans and specifications for a 300-ton concentrator have been approved by the directors, and the work of tearing down the old Basin mill has been started. As soon as the site is cleared, work on the new building will begin, it is said.

Boston-Montana Receiver Finds Ore

According to a statement made by C. S. Muffley, receiver of the Boston & Montana Development Co., two strikes of considerable importance were made on the property on the afternoon of April 28, on the 300 and 1,000 levels. The veins were about 8 ft. wide and, he says, assays 22 oz. silver, 3 per cent copper, and $1.60 in gold.

Freight Rates on Ore Discriminate

At a hearing before the State Railroad Commission at Helena, on May 2, testimony brought out the fact that present freight rates on ore shipments from Montana mines favor the smelters in Montana and do not permit ore to be profitably shipped from western Montana to smelters in Idaho. This was in the complaint of Attorney General W. D. Rankin for the state.

UTAH

Record Shipments From Park City Properties

The Park City Mining & Smelting Co. shipped during March 5,975 tons of ore and concentrates, and in April increased the weekly rate, sending out 1,732 tons the third week in April, this being the heaviest output for any week in the history of the company. At this mine the large orebody opened above the 900 level in the Daly West and Judge ground has been followed from 2,500 to 3,000 ft., the ore being continuous over this distance. The grade of the ore is such that the net smelter returns average from $45 to $50 per ton; concentrates net about $60.

The output from the Park-Utah under the same management in March broke the record of that property, which during the month and in the last few days of February shipped 11,242 tons of ore. This property's best week showed 2,592 tons of ore.

Tintic Output Larger

Tintic shipments for the week ended April 28 showed an increase of three cars over those of the week preceding, which, with 212 cars, had held the record. Shippers were: Chief Consolidated, 89 cars; Tintic Standard, 55; Iron Blossom, 14; Victoria, 10; Eagle & Blue Bell, 8; Colorado, 7; Iron King, 6; Colorado lease, No. 4, 3; Bullion Beck, 2; Plutus, 2; American Star, 1; Yankee, 1; May Day, 1; Little May, 1; Tintic Drain Tunnel, 1: 215 cars.

MICHIGAN

Henry Ford Seeks Iron Ore

Henry Ford has placed a second diamond drill in operation at Toleen's Spur, near Crystal Falls, on the Menominee iron range. A third drill is working near his Imperial mine, on the Marquette Range. Nothing has been given out regarding the results to date of this exploratory work. Ford is buying iron ore to meet his 1923 requirements, but it is evident that he desires other mines in order to mine all that he will need for his furnaces.

Larger Field for Pickands, Mather & Co.

Pickands, Mather & Co. are now operating the mines of the Penn Iron Mining Co., at Norway and Vulcan, on the Menominee Range. This was brought about because of the recent steel consolidations. The same company is also to operate the Mahoning pit, on the Mesaba Range, this season. No changes have been made in the management of any of the properties.

First Ore Boats Loaded

The first cargoes of iron ore were loaded at Escanaba, on Lake Michigan, on the last day of April, four vessels receiving ore that day. The opening of navigation on Lake Michigan is always a few days ahead of that on Lake Superior, due to the later opening of the Soo locks and St. Mary's River. The locks are now in operation, and boats are being loaded at Lake Superior ports. The season is opening later, but with a rush, and the movement should be a heavy one.

Reclamation Plant Progresses

All equipment for the reclamation plant which Calumet & Hecla is building on the Tamarack conglomerate tailing deposit in the Michigan copper district is on the ground, and shipment of dredge parts will be made soon. The dredge will be assembled at the Calumet & Hecla drydock at Point Mills.

MINNESOTA

Stripping Contract Let

Pickands, Mather & Co. has announced the letting of the contract for the stripping of its Corsica mine, situated near McKinley. This property was opened in 1901 and was operated as an underground property. It is estimated that the overburden to be removed will amount to 3,000,000 yd. A. Guthrie & Co. will do the stripping work.

10,000,000 Tons from One Pit

A banner year is anticipated at the Mahoning and Hull-Rust open pit operated by the Mahoning Ore Co. and the Oliver Iron Mining Co., respectively. These properties at Hibbing adjoin to form one immense open pit, and it is estimated that the shipments from the combined pit will amount to 10,000,000 tons. The operations will employ approximately 1,000 men.

The Situation at the Mines

By Arthur B. Parsons
Assistant Editor

SILVER OUTPUT for the time being holds the chief interest in the mining industry, as in most mining districts that metal forms an important part of the metal content of the ore. The unusual interest is a consequence of the recent assertion of the Director of the Mint that July 1 would mark the virtual completion of the repurchases of domestic silver at $1 per ounce under the terms of the Pittman Act. This announcement came as a distinct surprise to mining company officials, who had calculated that the purchases would not be completed much, if any, before Oct. 1. Vigorous effort is being made to have reversed the ruling of the government officials authorizing the revocation of certain allocations of silver to stocks of bullion used for subsidiary coinage. If this is successful, between 12,000,000 and 14,000,000 oz. will be "restored" to the amount of the total purchases and almost two months will be added to the period of dollar-silver production.

Silver Mining Center of Interest

Mining companies that are accustomed to ship silver-bearing ore to the smelters find one source of consolation in the assurance of the smelting companies that shippers will receive $1 for silver in ore delivered at smelting plants up to the last day before the Pittman Act purchases shall have been completed. Heretofore some uncertainty has existed as to this. The announcement of the smelting companies was made possible by an arrangement agreed to by the Director of the Mint whereby they, as the principal vendors, are to be allowed to make tenders of silver for future delivery to the mint, based on the silver content of all domestic ores received by them prior to the so-called expiration of the Pittman Act. This arrangement, on the other hand, aroused dissatisfaction and protest on the part of the "independent" producers, who do not market their silver through the smelting companies, but who deliver silver bullion directly to the mint. The Treasury Department has just issued supplementary regulations which permit silver in ores delivered to "any reduction plant producing bullion" to qualify for the Pittman Act price. Producers may tender such silver for future delivery provided sundry specific information regarding their operations and accounts is furnished the Treasury Department.

A question has been raised as to whether this ruling authorizing tenders for future delivery, in conjunction with the acceptance in 1920 of affidavits covering silver in ores mined during the four-month period immediately preceding the beginning of the Pittman Act purchases in May of that year, does not still discriminate against some independent producers.

Whatever settlement is finally made with respect to these questionable points, the agitation has served to emphasize the need for hastening production, and no effort is being spared at any of the camps to get silver out of the ground and on its way to reduction plants. Most operators look for a price of between 60 and 70c. in the world market when the Pittman Act purchases are complete. A difference of 35c. per ounce is a matter of serious consequence to all of them.

In the cyanide districts production is being pushed, and the richer ores are being milled; in the lead-silver districts the tendency is to mine the ore richest in silver irrespective of the lead content; in the copper and zinc mines where silver is an important metal a similar selection is made wherever practicable. In Canada and Mexico the situation is of course different. The appearance of the United States production on the world market with the completion of the $1 purchases may depress the price to some extent, but foreign producers seem to feel that the effect has probably been discounted already, and accordingly they are not greatly concerned.

The decline in the prices of the base metals has had little effect on the rate of production at the mines. At this writing copper is 16¼c., compared to 17c. a month ago, and lead brings 7½c. as against 8¼c. in March. Output of both, however, is increasing steadily, though not rapidly. On the other hand, the recession in zinc to 6¾ from 7½c. has had the effect of slackening output somewhat in the important Joplin-Miami field, so that the aggregate rate of output is doubtless less than it has been.

The labor situation is none too good. In Butte, the net loss of 1,000 miners who have departed for outside work during the spring and summer has been felt. The A. S. & R. Co. finally capitulated at Leadville, Colo., and ended a strike at its Yak Tunnel mine by increasing wages to the scale paid by the other companies in the district. Wages of 20,000 men working on the Lake Superior iron ranges were increased by from 10 to 15 per cent on May 1. In British Columbia, agreements were reached between employers and workers in two districts whereby increased wage scales were established. Miners at Oatman, Ariz., struck and were offered a 50c. increase; in northern Ontario demands for a raise of 20c. per hour were refused by the companies; dissatisfaction is reported from the Joplin-Miami district, where wages were cut 25c. Colorado and Arizona are both handicapped by inability to obtain as many miners as are needed.

In California, the Calaveras Copper Co. is about to start production. Gold mining is normal; silver output at Randsburg is at the maximum. Wages have just been raised in the Simon and Candelaria districts, in Nevada. Every silver mill in the state is going at full blast.

The larger lead-silver mines in Utah are breaking all records for output. The Tintic Standard sent out one carload of ore that assayed 1,016 oz. of silver and netted $64,727 from the smelter. Sixteen lead furnaces are in blast at the three smelters. In Idaho, the Bunker Hill smelter is producing 5,000 tons of lead and 250,000 oz. of silver per month. The whole Coeur d'Alene district is flourishing. Development in outside camps is suffering.

Phelps Dodge Copper Output to Be Increased

The Magma Copper Co. started shipping concentrate in April from it remodeled mill at Superior, Ariz. The Phelps Dodge Corporation has instructed its Morenci branch to increase output as rapidly as men can be obtained. About 800 will be required. Production in the Cripple Creek, Telluride, and Silverton districts, in Colorado, is hampered by labor shortage.

The Joplin-Miami zinc district is peculiarly sensitive to fluctuations in the market. The slump in zinc has put a brake on both output and development. Production is about 11,500 tons of concentrate per week. The Annapolis Lead Co., in southeast Missouri, is running its 500-ton mill regularly.

Michigan copper production dropped from 12,100,000 lb. in March to 11,575,000 lb. in April; this is attributable to labor shortage.

The first cargo of iron ore was shipped from Escanaba, on Lake Michigan, on April 30. Shipping from the Lake Superior ports is under way by this time. A big season is anticipated. The shipments, it is estimated, will total 60,000,000 tons. The price has been increased 50c. per ton.

The situation in northern Ontario has improved as a consequence of the break-up in the weather, giving an adequate supply of power at Porcupine. Around Sudbury, the Mond Nickel Co. has increased nickel production and the British America Nickel Corporation is preparing to resume, with 1,000 men employed. Activity in the Portland Canal district features British Columbian mining.

Conditions in Mexico show general improvement. Several transactions have been consummated recently whereby strong interests have taken over valuable properties that need capital for profitable exploitation. The A. S. & R. Co. has done this at Parral; the American Metal Co. in Durango; and both the Santa Gertrudis company and U. S. Smelting, Refining & Mining Co. at Pachuca.

THE MARKET REPORT

Daily Prices of Metals

May	Copper, N. Y. net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
3	16.125@16.25	44.75	45.625	7.50	7.35@7.45	6.75@6.90
4	16.00@16.25	44.25	45.00	7.50	7.25@7.35	6.875@7.05
5	16.00@16.25	43.75	44 75	7.50	7.25	6.95@7.15
7	16.00@16.25	43.50	44 50	7.25@7.50	7.20	6.90@7.10
8	16.00@16.125	42.625	43.50	7.25@7.50	7.15@7.20	6.75@7.00
9	16.00	42.875	43.75	7.25	7.15@7.20	6.75@6.90
Av.	16.104	43.625	44.521	7.417	7.250	6.923

*These prices correspond to the following quotations for copper delivered: May 3d, 16.375@16.50c.; 4th, 5th, and 7th, 16.25@16.50c.; 8th, 16.25@16.375c.; 9th, 16.25c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. The quotations are for prompt deliveries. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

May	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
3	70 7/8	71 5/8	79 1/2	215 1/2	215 1/2	25 3/4	25 7/8	31 3/4	32 1/4
4	70 3/8	71 1/8	79 1/2	213 1/4	213 1/4	25 3/8	25 5/8	31 3/4	32 3/8
7	70 1/2	71 1/4	79 1/2	210 1/4	210	25	24 7/8	32 1/8	32 5/8
8	69 5/8	70 1/4	79 1/4	206 1/2	206 1/2	24 5/8	24 1/2	31 3/4	32 1/4
9	68 1/2	69 1/8	79	206 1/2	206 1/2	24 1/2	24 1/4	31	31 1/4

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

May	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	May	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
3	4.63 1/4	99 3/8	67 7/8	32 13/16	7	4 61 7/8	99 3/8	67 3/8	32 3/4
4	4.62 1/8	99 3/8	67 3/4	32 13/16	8	4.61 3/8	99 5/8	67 3/8	32 7/8
5	4.62 1/4	99 3/8	67 3/4	32 15/16	9	4.61	99 5/8	66 7/8	32 9/16

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, May 9, 1923

Conditions are little different in the non-ferrous metal market from those that have existed during recent weeks. The international situation still dominates the market, and so long as London prices exhibit almost continuous declines from day to day, buyers on this side are likely to hold off. The time must soon come, however, when supplies will be needed for near-by consumption, and there is then likely to be a scramble for early deliveries. Germany is not taking anywhere near her normal requirements of metal, and as she is the most important consumer in Europe, her withdrawal from the market has had a bad effect. The Ruhr difficulty seems to be no less unsettled than last week, and there seems to be little hope of an immediate improvement. Without a stronger feeling in the London metal market, prices cannot advance here until buying in substantial volume appears. The bright spot is that consumption has not fallen away to any great extent and buyers must soon come into the market for at least small tonnages to meet current requirements.

Copper

Buying has continued on the extremely small scale of recent weeks, but the effort to sell is somewhat more pronounced. On Thursday, Friday, and Saturday several sales were made as high as 16.50c. delivered, but on Monday all buying strength seemed to have evaporated. Copper was freely offered yesterday at 16⅜c. and at 16.25c. by at least three interests, without tempting consumers at either level. In fact, they indicated that they preferred not to buy at any price, but would sit back and see how far the decline would go. Nothing under 16.25c. has so far been reported on actual business where freight rates are normal, but consumers say they would be afraid to offer to buy a round lot at even 16c. delivered if they were not prepared to take the copper. Most of the large producing interests are well sold up and are not pressing any metal on the market, but all would probably be willing to sell now at 16.50c. delivered.

The export demand has continued very weak. The Copper Export Association has done little or nothing, leaving the business to outside interests who have made a few sales netting between 16 and 16¼c. f.o.b. refinery.

Lead

The American Smelting & Refining Co. reduced its official contract price of lead from 7.75c. to 7.50c. on Thursday, May 3. Today, May 9, a further reduction was made to 7.25c.

Continued declines in London, and offerings of Spanish lead in this market, have been alone responsible for the price decline. Consumption continues unabated apparently, and prompt supplies of lead are exceedingly scarce, many producers being behind in their deliveries. The weakness in London is due rather to lack of demand than increased production; the output of Spain, for example, has actually decreased, it is reported, from about 10,000 tons in December to 8,000 tons in March. The volume of sales here at the reduced prices is small, lead buyers, like the copper buyers, waiting to see if the metal will not be still cheaper before ordering.

There has been some pressure to sell chemical lead on the St. Louis market, but desilverized seems to be in scant supply.

Zinc

The market had an upswing during the week, but it was of very short duration. The galvanizers remain slightly interested in both spot and forward position, and sales have been small in volume. The wide difference between the price of prompt zinc and that for

future shipment continues, with the bulk of the business transacted for delivery of metal in July and August. Early in the week prompt zinc was quoted at 6.90c., with forward metal at 6.75c. The highest price reached on the advance was 7.15c. The market today is at the level of last Thursday. There is a feeling in the trade that production is being pushed too strongly, particularly in view of the unsatisfactory situation abroad. The price of high-grade metal is 8.50@9c. per lb., with 30c. per 100 lb. freight allowance. Sales of high-grade metal have been excellent.

Tin

Tin prices here have followed the decline in London without stimulating any great amount of interest by buyers. Tin-plate companies are showing a little interest in third- and fourth-quarter metal, however, and the demand is slightly improved. Forward deliveries have commanded from one-quarter to one-half cent premium.

Arrivals of tin, in long tons: May 1st, Straits, 40; China, 50; 2d, Liverpool, 50; Straits, 15; 4th, Straits, 760; Java, 25; 7th, Straits, 475; 8th, China, 25; total so far in May, 2,755.

Gold

Gold in London: May 3d, 88s. 10d.; 4th, 89s.; 7th, 89s. 1d.; 8th, 89s. 3d.; 9th, 89s. 3d.

Foreign Exchange

On Tuesday, May 8, cable quotations on francs were 6.6325c.; lire, 4.845c.; marks, 0.0027⅞c.; and Canadian dollars, 1⅜ per cent discount.

Silver

The market has been quiet of late, with a slightly easier tendency, and offerings continue scarce, particularly for near-by delivery.

In the average prices for April published last week, page 820, the price of domestic silver should be 99.625c.

Mexican Dollars—May 3d, 51¾; 4th, 51¾; 5th, 51¾; 7th, 51⅝; 8th, 51⅝; 9th, 51.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—General market for 99 per cent grade, 27c. per lb.; 98 per cent, 26c. London £110@£115.

Antimony — Chinese and Japanese brands, 7⅝c. W.C.C., 8¼c. Cookson's "C" grade, spot, 10@10½c. Chinese needle antimony, lump, nominal, 5½c. per lb. Standard powdered needle antimony, 200 mesh, at 6@6½c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 8@8½c.

Bismuth—$2.55 per lb. London, 10s.

Cadmium—$1@$1.10 per lb. London, 5s.@5s. 3d.

Iridium—$260@$275 per oz.

Nickel—28@31c. per lb. for 99 per cent virgin metal. London, £135 per long ton.

Palladium—$81 per oz.

Platinum — $116 per oz. London, sponge, £22.

Quicksilver—$68 per 75-lb. flask. San Francisco wires $67.35. London, £10.

The prices of **Cobalt, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Selenium, Tellurium, Thallium** and **Tungsten** are unchanged from prices given May 5.

Metallic Ores

Chrome Ore—Indian chrome ore, $20.50 per ton, c.i.f. Atlantic ports. New Caledonian, $24@$26 per ton. Rhodesian, $20@$22.

Manganese Ore—40@45c. per long ton unit, seaport, plus duty.

Molybdenum Ore—75@85c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates plus duty.

Tungsten Ore—Wolframite, $8.25@$8.50; scheelite, $8.50@$9 per unit of WO_3, f.o.b. New York.

Iron Ore, Magnetite, Tantalum, Titanium, Uranium, Vanadium, and **Zircon Ore** are unchanged from the quotations published May 5.

Zinc and Lead Ore Markets

Joplin, Mo., May 5—Zinc blende, per ton, high, $48.50; basis, 60 per cent zinc, premium, $42; Prime Western, $40@$41; fines and slimes, $40@$37; average settling price, all blende, $42.25. Calamine, basis 40 per cent zinc, $25@$26; average, $27.33 per ton.

Lead, high, $115.05; basis 80 per cent lead, $95@$90; average settling price, all lead, $113.03 per ton.

Shipments for the week: Blende, 9 953; calamine, 120; lead, 2,502 tons. Value, all ores the week, $707,610.

Buyers tried to hold the basis price of Prime Western grades of blende down on a $40 basis, but, failing to fill orders, because sellers would not accept that price level, perhaps two-thirds of the 12,190 tons bought this week sold on the $41 basis. Shipments from purchases on as high as $45 basis are still being made, as indicated by the high price and the high average price of all ores. Lead felt a further decline, being quoted this morning at $95, at noon at $92.50 and this evening at $90 basis.

Platteville, Wis., May 5—Blende, basis 60 per cent zinc, $43 per ton. Lead, basis 80 per cent lead. $105 per ton. Shipments for the week: Blende, 1,179 tons; lead, none. Shipments for the year: Blende, 12 416; lead, 220 tons. Shipments for the week to separating plants, 2,717 tons blende.

Non-Metallic Minerals

Asbestos—Crude No. 1, $500; No. 2, $250@$325; long spinning fibers, $135@$200; magnesia and compressed sheet fiber, $100@$150; shingle stock $65@$85; paper stock, $35@$42; cement stock. $20@$25; shorts, $9@$14—all per short ton, f.o.b. mines, Quebec, Canada.

Wage increase of 20 per cent went into effect April 1, 1923. Market prices stiffening.

Bauxite, Barytes, Borax, Chalk, China Clay, Diatomaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Manjak, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, Talc and **Tripoli** are unchanged from the May 5 prices.

Mineral Products

Arsenious Oxide (white arsenic)—13½@14½c. per lb. for prompt. June, 12½c. Second half 1923, 11c.

Copper Sulphate, Potassium Sulphate, Sodium Nitrate, and **Sodium Sulphate** are unchanged from quotations of May 5.

Ferro-Alloys

Ferromanganese — Domestic, 78@8. per cent, $120 per gross ton, f.o.b. furnace. Spiegeleisen, 19@21 per cent, $40, f.o.b. furnace; 16@19 per cent, $39.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium, and **Ferrovanadium** are unchanged from the prices published May 5.

Metal Products

Copper Sheets—Base price 25½c. per lb. Wire, 19⅜c.

Lead Sheets, Zinc Sheets, Nickel Silver and **Yellow Metal** are unchanged from the prices given in the May 5 issue.

Refractories

Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick and **Zirkite** are unchanged from the May 5 prices.

The Iron Trade

Pittsburgh, May 8, 1923

Production of both pig iron and steel is well maintained, with a considerable gain in pig iron over the March rate and a slight gain in steel. The novel condition, since 1916, exists of coke being plentiful at a time when industry is active, and for several weeks Connellsville coke operators have had to curtail production.

Signs are increasing of the very heavy deliveries of steel in the past few months making an impression on the situation. Delivery premiums are decreasing and the volume of premium business is less. Moderately early deliveries can now be secured at basis prices which average 45 to 50 per cent above the level at the post-war low point, early in March, 1922.

The Ford Motor Co. has instructed that shipments to it of cold-finished bars and cold-rolled strip steel be suspended for May and there are possibilities of other suspensions being ordered. Consumption of steel promises to continue at the present rate for many months, but production may now be running at somewhat above consumption.

Finished steel prices are firm, with no changes in the last week.

Pig Iron—The market continues stagnant and the price of $31, Valley, reached late in March for bessemer, basic, foundry and malleable, is now more or less nominal, it being thought that a buyer of a round tonnage could shade it.

Connellsville Coke—Spot: Furnace, $6@$6.25; foundry, $7@$7.50.

COMPANY REPORTS

Utah Copper Co.

A report of the operations of the Utah Copper Co. for 1922 shows a net income of $1,687,999.81 as follows:

Operating revenue		
Copper produced—84,777,7121b. @ 13.584..	$11,516,125.01	
Gold produced—28,283.7685 oz. @ $20.00...	565,675.37	
Silver produced—257,145.060 oz. @ 99.502c.	255,864.67	
		$12,337,665.05
Operating expenses		
Mining, including stripping expense	$1,625,197.05	
Ore delivery—mine to mill	651,096.42	
Milling	3,049,417.56	
Treatment, freight, and refining	2,384,704.06	
Selling expense	148,572.89	
		7,858,987.98
Profit from operations		$4,478,677.07
Miscellaneous income—net		411,573.58
Total income		$4,890,250.65
Charges against income		
Depreciation	$1,011,002.53	
Loss on plant and equipment retired, replaced, superseded or abandoned	295,102 27	
Flotation litigation settlement, shutdown expense	1,896,146.04	
		3,202,250.84
Net income to surplus account		$1,687,999.81
Balance Dec. 31, 1921		$38,058,088.54
Net income for year (without deduction for depletion)		1,687,999.81
		$39,746,088.35
Less capital distributions		3,248,980.00
Balance of surplus Dec. 31, 1922		$36,497,108.35

Balance sheet as of Dec. 31, 1922, is given as follows:

Mining and milling properties and equipment	$29,511,873.28	
Railway property and equipment	6,773,143.90	
	$36,285,017.18	
Less reserve for depreciation	8,004,013.71	
		$28,281,003.47
Investments		5,837,859.63
Deferred charges to operations		11,390,115.33
Copper Export Association, Inc., suspense		756,295.11
Bond deposit account		270,000.00
Current assets		
Cash	$3,309,186.53	
Cash due for copper deliveries	985,534.09	
Marketable securities	6,281,918.30	
Accounts receivable and prepaid insurance	838,586.47	
Metals on hand and in transit	5,834,767.50	
Materials and supplies	2,931.082.20	
		$20,181,075.09
		$66,716,348.63

Liabilities

Capital stock outstanding (Utah Copper Co.)		$16,244,900.00
Current liabilities		
Accounts payable	$640,586.37	
Accrued treatment, refining, and delivery charges	999,236.97	
Reserve for taxes	2,204,281.63	
		3,844,104.97
Surplus from sale of securities		8,290,620.00
Surplus from operations		38,336,723.66
		$66,716,348.63

Production amounted to 88,033,353 lb. of copper. Costs were 9.27c. per lb. exclusive of depreciation and miscellaneous credits; net costs were 7.82c. per lb.

The New Jersey Zinc Co.

A statement for the quarter ended March 31, 1923, of operations of the New Jersey Zinc Co. follows:

Income (including dividends from subsidiary companies) after deductions for expenses, taxes, maintenance and repairs, depreciation, depletion and contingencies	$1,905,455.79
Deduct interest on first mortgage bonds	40,000.00
Net income	$1,865,455.79
Deduct dividend 2 per cent payable May 10, 1923	964,706.00
Surplus for the quarter	$900,749.79

Nevada Consolidated Copper Co.

A report of the operations of the Nevada Consolidated Copper Co. for 1922 shows a loss of $1,123,622.75 according to the following account:

Statement of Operations

Operating revenue		
Copper produced—23,762,675 lb. @ 13.61c., f.o.b. Atlantic seaboard	$3,234,430.21	
Gold and silver produced	166,531.13	
		$3,400,961.34
Operating expenses		
Mining, including proportion of stripping expense	$962,469.91	
Ore delivery—mine to mill	195,899.03	
Milling	469,097.52	
Smelting	985,245.08	
Freight and refining	370,898.33	
Selling commission	29,579.66	
		3,014,189.53
Profit from operations		$386,771.81
Miscellaneous income		
Dividends—Nevada Northern Railway Co.	$500,000.00	
Interest, rentals, and miscellaneous—net	60,446.13	
		560,446.13
Total income		$947,217.94
Charges against income		
Depreciation	$879,194.28	
Flotation litigation settlement, mill fire loss, shutdown expenses	1,191,646.41	
		2,070,840.69
Net loss to surplus account		$1,123,622.75

Surplus from Operations

Balance Dec. 31, 1921	$4,905,437.84
Loss for year (exclusive of any deduction for depletion)	1,123,622.75
Balance of surplus Dec. 31, 1922	$3,781,815.09

Balance sheet as of Dec. 31, 1922, of the Nevada Consolidated Copper Co. and the Nevada Northern Railway Co. combined is given as follows:

Assets

	Dec. 31, 1922	Dec. 31, 1921
Property, equipment and construction	$19,919,412.89	$21,389,593.62
Less ore extinguishment and depreciation	11,624,293.34	12,858,047.98
	$8,295,119.55	8,531,545.64
Investments in securities and rights	58,599.23	58,599.23
Deferred charges to mining operations	5,691,376.40	5,448,866.83
Copper Export Association, Inc., suspense	409,866.77	524,794.34
Bond deposit account	75,000.00	.....
Materials and supplies on hand	1,619,570.94	1,567,068.72
Accounts and notes collectible	332,643.03	656,854.83
Deferred accounts	599,947.97	532,511.95
Metals on hand and in transit	2,476,334.53	2,644,688.50
Marketable securities	235,534.00	235,534.00
Cash	2,946,593.17	3,419,452.02
	$22,740,585.59	$23,619,916.06

Liabilities

Capital stock outstanding (Nevada Consolidated Copper Co. only)	$9,997,285.00	$9,997,285.00
Surplus (from capital stock and securities sold in excess of par value or cost)	7,071,850.17	7,071,850.17
Accounts payable (not due)	807,505.76	456,650.46
Deferred accounts	82,647.01	73,744.05
Unpaid treatment on metals (not due)	363,547.49	343,172.48
Surplus from operations	4,417,750.16	5,677,213.90
	$22,740,585.59	$23,619,916.06

Production amounted to 23,762,675 lb. of refined copper at a cost of 9.62c. per lb. excluding depreciation.

Michigan Copper Mining Co.

A report of operations of Michigan Copper Mining Co. for 1922 shows current assets of $60,014.70 and current liabilities of $369,759.72. The mine was not operated in 1922.

Nipissing Mines Co. and Nipissing Mining Co.

Silver; Ontario

A report of the operations of the Nipissing Mines Co., Ltd., for 1922 shows a net profit of $1,485,708.04, according to the accounts of its subsidiary company, the Nipissing Mining Co., which follow:

Gross settlements		
1921 Custom residue (shipments paid for in 1922)		$10,485.00
1922 Ore and bullion (shipments paid for in 1922)		2,681,595.13
Gross settlements for the year		$2,692,080.13
Gross value of ore, bullion and residue at mine, shipped and outstanding, Dec. 31, 1922		891,386.51
		$3,583,466.64
Less gross value of custom ore purchased	$20,065.93	
Gross value of inventory Dec. 31, 1921	1,031,047.07	
		1,051,113.00
Gross value of 1922 ore—Nipissing production		$2,532,353.64
Cost of mining and all other expenses	$1,154,529.85	
Less other income at Cobalt	27,008.93	
Net cost of production		1,127,520.92
Net income for 1922 production		$1,404,832.72
Add interest on $1,700,000.00 Canadian Victory Bonds	$93,500.00	
Other interests at New York, Boston, Toronto, etc	51,427.73	
		144,927.73
		$1,549,760.45
Less cost and work on outside properties		64,052.41
Net profit		$1,485,708.04
Surplus Jan. 1, 1922		3,851,242.94
		$5,336,950.98
Less dividends declared and paid during 1922	$760,000.00	
Dividend payable Jan. 1, 1923	360,000.00	
		1,120,000.00
Net surplus		$4,216,950.98

Balance sheet as of Dec. 31, 1922, is given as follows:

Assets

Mining property		$250,000.00	
Milling plants	$711,939.56		
Less depreciation reserve	709,792.18		
		2,147.38	$252,147.38
Current, cash, etc			2,359,900.52
Investments: Bonds and properties			2,440,626.08
Total			$5,052,673.98

Liabilities and Capital

Capital stock issued and outstanding		$250,000.00
Current		
Accounts payable—including taxes	$198,794.80	
Dividends payable—Jan. 1923	360,000.00	
Accrued expenses on ore, bullion, and residue	26,928.20	
		585,723.00
Earned surplus (per statement of operations)		4,216,950.98
Total		$5,052,673.98

The accounts of the Nipissing Mines Co. show a total of $1,120,000 received in dividends from the Nipissing Mining Co. and dividends of $1,080,000 paid to shareholders of the Nipissing Mines Co. on the $6,000,000 capital stock of the company. Production amounted to 3,423,115 oz. of silver.

Consolidated Mining & Smelting Co.

A report of the operations of the Consolidated Mining & Smelting Co. of Canada, Ltd., for 1922, shows a profit of $1,288,329.94, according to the following account:

Ores, metals and smelter product on hand and in transit at Dec. 31, 1921	$2,779,434.41
Custom ores, lead and bullion purchased	1,194,389.06
Freight on ore from company's mines	645,808.79
Mining, smelting and general expenses	4,381,424.14
Development expense	306,772.19
Capital renewals and depreciation	405,145.06
Provision for depletion of mineral properties	320,750.85
Bond interest and exchange on coupons	239,198.17
Interest on loans	239,549.13
Directors' fees	3,550.00
Sundry items written off	10,335.64
Balance—profit	1,228,329.94
	$4,754,688.38
Sales of smelter product, ore	9,576,201.17
Ores, metals and smelter product on hand and in transit at Dec. 31, 1922	2,023,763.92
Rents, royalties, and sundry revenues	26,243.29
West Kootenay Power & Light Co., Ltd., dividends	128,480.00
	$11,754,688.38

Balance sheet as of Dec. 31, 1922, is given as follows:

Liabilities

Capital			
Authorized			
600,000 shares at $25 each		$15,000,000.00	
Issued and fully paid			
421,348 shares at $25 each			$10,533,700.00
Bonds			
Authorized	$7,500,000.00		
Issued and sold			4,000,000.00
Hypothecated as security for special loan	2,000,000.00		
Special loan			2,000,000.00
Other bank loans and overdraft			1,271,086.66
Bond interest accrued with exchange thereon			140,148.62
Reserves for taxes			222,851.21
Accounts payable			1,118,907.87
Contingent liability		$27,189.80	
Profit-and-loss account			
Balance Dec. 31, 1921		$1,079,736.90	
Profit for year ended Dec. 31, 1922		1,228,329.94	
		$2,308,066.84	
Less income and mineral taxes paid and reserved for		252,881.63	
			2,055,185.21
			$21,341,879.57

Assets

Mines, mineral claims and shares in other companies			
Balance Dec. 31, 1921		$10,384,620.07	
Expenditure for year ended Dec. 31, 1922		110,340.15	
		$10,494,960.22	
Less provision for depletion		320,750.85	
			$10,174,209.37
Mining, smelting, concentrating and refining plants			
Balance Dec. 31, 1921		6,473,872.69	
Expenditure for year ended Dec. 31, 1922		1,283,829.10	
		$7,757,701.79	
Less capital renewals and depreciation		405,145.06	
			7,352,556.73
Ores, metals and smelter products on hand and in transit			2,023,763.92
Mines and smelter stores and material			1,510,983.33
Accounts receivable, less reserve			247,689.09
Insurance paid in advance			28,542.84
Cash in bank and on hand			4,134.29
			$21,341,879.57

Production amounted to 18,864 oz. of gold, 2,116,351 oz. of silver, 84,352,017 lb. of lead, 1,243,952 lb. of copper, and 55,564,960 lb. of zinc.

Imports of Ores and Metals in January, 1922 and 1923

Imports of copper, lead, and zinc during January, 1923, with revised comparative figures for January, 1922, as compiled from Department of Commerce data, follow:

Imports January, 1922 and 1923

In Pounds Unless Otherwise Stated

	January, 1922	1923
Antimony		
Ore	.....	264,703
Metal, matte and regulus	1,070,781	450,240
Copper and brass		
Ore	4,754,304	2,545,083
Concentrates	119,147	5,136,981
Regulus, coarse metal and cement copper	2,263,525	55,474
Total	7,136,976	7,737,538
Imported from:		
Spain	1,412,679	310,298
Canada	636,857	235,328
Mexico	2,211,238	3,923,675
Cuba	.....	1,821,571
Chile	463,499	1,064,841
Colombia	.....	55,474
Peru	24,834	102,861
Other countries	2,387,869	223,490
Unrefined black, blister and converter copper in pigs and bars	5,178,068	18,728,213
Imported from:		
Spain	.....	2,386,112
United Kingdom	.....	35,821
Canada	.....	643,261
Mexico	1,318,384	3,544,361
Chile	827,335	823,275
Peru	3,024,299	271,675
Portuguese Africa	.....	9,382,749
Other countries	8,050	1,640,959
Refined copper	13,519	11,034,505
Old and clippings for remanufacture	551,920	406,944
Composition metal, copper chief value	.....	89,298
Copper manufactures	.....	10,503
Brass		
Old and clippings for remanufacture	11,782,644	2,391,176
Manufactures of brass	.....	26,481
Lead		
Ore and matte	215,189	647,344
Bullion or base bullion	12,651,067	25,919,542
Pigs, bars, other forms and old	302,871	1,481,931
Manufactures of lead (except type metal)	.....	10,101
Manganese ore, long tons	9,500	.....
Tungsten ore, long tons	.....	.....
Pyrites, long tons	30,243	89,645

Imports of Ores and Metals (Continued)

Tin		
Tin ore	79	1,070
Tin in bars, blocks and pigs	9,102,703	13,165,354
Imported from:		
United Kingdom	3,423,534	.....
British Straits Settlements	5,367,632	8,155,123
China	.....	840,189
Dutch East Indies	.....	1,918,902
Hongkong	67,377	2,010,562
Australia	244,160	.....
Other countries	.....	240,578
Zinc ore (free)	.....	11,454
Zinc in blocks and pigs	.....	1,500

Exports of Ores and Metals in February, 1922 and 1923

Exports of copper, lead, and zinc during February, 1923, with revised comparative figures for February, 1922, as compiled from the returns to the Department of Commerce, were as follows:

Exports of Copper, Lead and Zinc

In Pounds

	February, 1922	February, 1923
Copper		
Ores, concentrates, matte, and regulus (copper content)	1,180	.....
Copper and manufactures of (total)	53,963,197	50,689,451
Unrefined, black and blister	.....	.....
Refined, in ingots and bars	48,676,879	43,810,158
Exported to:		
Belgium	4,466,146	1,828,598
France	10,494,459	10,035,918
Germany	14,302,424	10,513,771
Italy	3,083,672	3,878,438
Netherlands	2,969,089	2,587,515
Spain	392,818	954,030
Sweden	336,380	2,267,453
United Kingdom	3,799,420	8,965,862
Canada	27,269	763,057
China	1,131,200	1,400,000
Japan	7,391,915	.....
Other countries	282,087	615,516
Old and scrap	245,194	242,809
Composition metal, copper chief value	1,840	3,993
Pipes and tubes	85,823	66,934
Plates and sheets	1,320,290	447,977
Wire except insulated	447,081	698,107
Insulated wire and cable	508,807	821,949
Lead		
Pigs and bars		
From domestic ore	2,056,119	336,247
From foreign ore	7,140,498	5,873,351
Exported to:		
France	2,240,972	1,456,722
Germany	3,809,909	1,120,684
Netherlands	226,320	224,135
United Kingdom	1,572,766	2,072,682
Argentina	120,878	489,593
Brazil	280,141	492,922
Japan	448,125	.....
Other countries	497,507	352,860
Zinc		
Dross	3,107,727	1,462,949
Spelter		
From domestic ore	462,211	12,142,945
From foreign ore	.....	1,200,650
Total zinc slabs and blocks	462,211	13,343,595
Exported to		
Belgium	.....	224,028
France	.....	112,013
United Kingdom	.....	12,623,810
Canada	10,206	2,504
Japan	224,055	.....
Other countries	227,950	381,240
In sheets and strips	390,428	627,411
Dust	210,794	534,862
Other zinc manufactures	197,057	57,710

Gold Production of the Transvaal

The output of gold of the mines of the Transvaal during the month of March amounted to 761,586 oz. of fine gold, as compared with 704,970 oz. during February. The output in the first three months of 1922 amounted to 639,728 oz. The following table shows the production for a number of years:

Transvaal Gold Production 1917-1923

In Fine Ounces

	1917	1918	1919	1920	1921	1922	1923
Jan.	782,634	714,182	676,059	670,503	651,593		764,469
Feb.	781,321	659,759	636,728	625,330	558,137	639,728	704,970
March	787,094	696,281	712,379	707,036	671,123		761,586
April	742,778	717,000	694,944	686,979	681,382	511,338	.....
May	779,385	741,317	724,995	699,041	687,776	629,786	.....
June	759,724	727,696	702,379	715,957	678,490	675,697	.....
July	757,839	736,199	725,497	736,099	689,555	730,635	.....
Aug.	756,658	740,210	706,669	702,083	711,526	752,490	.....
Sept.	738,231	708,206	698,558	682,173	691,026	747,089	.....
Oct.	751,290	679,764	723,722	662,472	707,825	778,159	.....
Nov.	722,839	658,701	677,970	633,737	704,236	764,476	.....
Dec.	722,419	641,245	650,191	632,215	681,847	790,712	.....
Totals	9,018,084	8,418,292	8,330,091	8,153,625	8,114,516	7,020,111	2,231,025

Facts for the Stockholder

XVI—International Nickel Co.

THE INTERNATIONAL NICKEL CO. was incorporated in New Jersey, in March, 1902. In September, 1912, a new company was organized by the consolidation of the International Nickel Co. and the Colonial Nickel Co., which owns the entire capital stock of the International Nickel Co. of Canada, Ltd., formerly the Canadian Copper Co., the Société Minière Caledonienne, New Caledonia, and the Huronian Co., Ltd., Ontario; and a controlling interest in the Nickel Corporation, Ltd., of Great Britain.

Properties include about 18,000 acres, mostly in the south range of the Sudbury nickel belt. The chief ore minerals are pyrrhotite, chalcopyrite, and pentlandite, the ore occurring in the form of massive sulphides. The Creighton mine contains the greatest deposit of well-developed nickel-copper ore in the world, and is the present operating mine of the company. It is developed to a vertical depth of over 1,000 ft., by three inclined shafts, the main shaft having an inclined depth of over 1,900 ft., and extends below the 23d level. The Creighton orebody is an irregular lens, having a length of about 2,500 ft., depth varying from 400 to 1,000 ft., and a width of 100 to 375 ft. Production has been at the rate of about 3,500 tons a day.

The company is the largest producer in the world of copper-nickel ore and matte, and the developed ore reserves are estimated at 20,000,000 tons. Equipment includes most efficient modern surface and underground hoisting, haulage, and ore-sorting plants at the Creighton mine, smelting plant at Copper Cliff, Ont., refinery at Port Colborne, and rolling mills at Huntington, W. Va.

Following the armistice, the company's business fell off rapidly, and properties were completely shut down in September, 1921. In July, 1922, the new Huntington plant started, and in September operations were resumed at the mine and smelter. In November, 1922, the Port Colborne refinery was operating at capacity, and the company was selling about 1,500,000 lb. of nickel, and 500,000 lb. of Monel metal monthly. Monel metal contains about 67 per cent nickel and 28 per cent copper. In February, 1923, the company was at nearly pre-war production.

Capital stock consists of 89,126 shares of 6 per cent non-cumulative preferred stock, par value $100; and 1,673,384 shares of common stock, par value, $25. There is no funded debt. In the event of any liquidation or dissolution, the holders of the preferred stock are to be paid in full at par.

Preferred stockholders have four votes for each share held, while holders of the common stock have one vote for each share held. The authorized preferred stock is 120,000 shares, and the authorized common stock is 2,000,000 shares. The number of stockholders has increased from 4,465 in 1915 to 17,714 in 1922.

Net income was around $5,000,000 per annum during the years 1913, 1914, and 1915, rose to $13,550,000 in 1917, the company's most profitable year, and thereafter declined to about $2,000,000 in 1921, running into a deficit of about $800,000 in 1922, according to accounts for the fiscal year ended March 31, 1922. During the last six months earnings have recovered, and financial statement for nine months ended Dec. 21, 1922, shows a small net income for the period.

Current assets were about $10,590,000 on Dec. 31, 1922, compared to current liabilities of $576,000, leaving working capital at about $10,000,000. The company is reported in a strong position, with cash and securities now about $3,000,000. Net assets applicable to common stock are estimated at about $30 a share.

Dividend record is as follows: Preferred stock, 1½ per cent in 1912, and 6 per cent per annum thereafter to date. Common stock, $2 a share in 1912, $10.50 in 1913, $10 in 1914, $17.50 in 1915 (also 10 per cent in stock on Nov. 1, 1915), $6.25 in 1916, $5.75 in 1917, $4 in 1918, and a last payment, 50c. a share, in March, 1919.

Price range of stock since listing on the New York stock Exchange in 1915: Preferred, high 111¾ in 1916, low 60 in 1921 and 1922, closing price 78, May 8, 1923. Common, high 56⅛ in 1916, 11⅛ in 1920, closing price 14½, May 8, 1923.

INVESTIGATOR.

MINING STOCKS

Week Ended May 5, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	80	72	74	Mar. 23, Q	$1.00
Alaska-Br. Col.	N. Y. Curb	1⅞	1⅜	1⅝		
Allouez	Boston	24	23¼	24	Mar. '19	1.00
Anaconda	New York	48¾	46	46¾	Apr. '23, Q	0.75
Arcadian Consol.	Boston	2	2¼	2¼		
Ariz. Com'l.	Boston	12¼	11	11¼	Oct. '18, Q	0.50
Calaveras	N. Y. Curb	3⅛	3¼	3¼		
Calumet & Arizona	Boston	58	55½	57	Mar. '23,	1.00
Calumet & Hecla	Boston	400	372	397	Mar. '23, Q	7.00
Centennial	Boston	11	10	10	Dec. '18, SA	1.00
Cerro de Pasco	New York	45½	43	45½	May '23,	1.00
Chile Copper	New York	27⅞	26⅛	27¼	Mar. 23,	0.62
Chino	New York	26⅛	24⅛	24⅛	Sept. '20, Q	0.37
Con. Coppermines	N. Y. Curb	3¼	2⅜	3		
Copper Range	Boston	39	36⅜	36⅛	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1⅜	1 1/16	1 1/16		
Davis-Daly	Boston	3¼	3⅛	3⅛	Mar. '20, Q	0.25
East Butte	Boston	8 1/16	7⅜	8	Dec. '19, A	0.50
First National	Boston Curb	*52	*50	*50	Feb. '19, SA	0.15
Franklin	Boston	1⅞	1⅜	1⅜		
Gadsden Copper	N. Y. Curb	*65	*65	*65		
Granby Consol.	New York	28⅜	25⅞	26⅛	May '19, Q	1.25
Greene-Cananea	New York	27⅛	24⅜	25⅛	Nov. '20, Q	0.50
Hancock	Boston	3⅜	3	3		
Howe Sound	N. Y. Curb	3¼	3	3⅛	Jan. '21, Q	0.05
Inspiration Consol.	New York	37⅛	35	35⅛	Apr. '23, Q	0.50
Iron Cap	Boston Curb	7⅛	7¼	7⅛	May 23, K	0.15
Isle Royale	Boston	27	23⅛	25	Mar. '23, Q	0.50
Kennecott	New York	39½	36⅜	39	Apr. '23, Q	0.75
Keweenaw	Boston	1⅛	1⅛	1⅛		
Lake Copper	Boston	†4	†3	3⅜		
Magma Copper	New York	33⅛	32	32⅛	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	2⅛	2⅛	2⅛		
Mass Consolidated	Boston	3	1⅞	2	Nov. '17, Q	1.00
Miami Copper	New York	29⅛	27	27⅛	Apr. '23, Q	0.50
Michigan	Boston	2⅛	1⅞	1⅞		
Mohawk	Boston	56	54	54	Mar. '23, Q	1.00
Mother Lode Coa.	New York	11	9⅞	10⅛	Mar. '23, K	0.50
Nevada Consol.	New York	14⅝	14	14⅛	Sept. '20, Q	0.25
New Cornelia	Boston	19⅜	17⅛	17⅜	Feb. '23, Q	0.25
North Butte	Boston	9⅛	8⅜	8⅜	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*80	*68	*73		
Old Dominion	Boston	25⅛	25	25	Dec. '18, Q	1.00
Osceola	Boston	36	33⅛	34	Mar. '23, K	1.00
Phelps Dodge	Open Mar.	†190	†182		Apr. '23, Q	1.00
Quincy	Boston	39⅛	37	38⅛	Mar '20, Q	1.00
Ray Consolidated	New York	15	14⅛	15	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	1⅛	1⅛	1⅛		
St Mary's Min. Ld.	Boston	44	42	44	Mar. '23, K	3.00
Seneca Copper	New York	8⅛	8	8		
Shannon	Boston	*80	*70	*70	Nov. '17, Q	0.25
Shattuck Arizona	New York	8⅛	7⅛	7⅛	Jan. '20, Q	0.25
South Lake	Boston	†*75	†*35	*50		
Superior & Boston	Boston	2	1⅞	2		
Tenn. C. & C. cfs.	New York	11	10⅛	10⅜	Apr. '23, Q	0.25
Tuolumne	Boston	*42	*40	*40	May '13,	0.10
United Verde Ex.	N. Y. Curb	37	35	35	May '23, Q	1.00
Utah Consol.	Boston	2	1⅞	2	Sept '18,	0.25
Utah Copper	New York	68⅜	64½	68⅛	Mar. '23, Q	1.00
Utah Metal & T.	Boston	*96	*80	*85	Dec. '17,	0.30
Victoria	Boston	1⅜	1⅛	1⅛		
Winona	Boston	*91	*70	*70		
Wolverine	Boston	9	8⅛	8½		
NICKEL-COPPER						
Internat. Nickel	New York	14⅛	13⅛	14⅛	Mar. '19,	0.50
Internat. Nickel, pfd.	New York	76⅛	76	76⅛	May '23, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	5	4⅜	4⅜		
National Lead	New York	126⅜	120	121⅛	Mar. '23, Q	2.00
National Lead, pfd.	New York	111⅛	111⅛	111⅛	Mar. '23, Q	1.75
St. Joseph Lead	New York	20	19	19⅛	Mar. '23, Q,X	0.50
ZINC						
Am. Z. L. & S.	New York	15⅞	14⅛	14⅛	May '20,	1.00
Am. Z. L. & S. pfd.	New York	51⅛	50⅜	50⅜	Nov. '20, Q	1.50
Butte C. & Z.	New York	8⅛	7⅜	8	Mar. '23,	0.50
Butte & Superior	New York	29⅜	27	27⅜	Mar. '23, Q	0.50
Callahan Zn-Ld	New York	8⅛	7⅛	7⅜	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	172	162	165	Feb. '23, Q	2.00
United Zinc	N. Y. Curb	1⅛	1⅛	1⅛		
Yellow Pine	Los Angeles			*65	Sept. '20, Q	0.03
SILVER						
Alvarado	N. Y. Curb	5	5	5		
Batopilas Mining	New York	⅜	⅛	¼	Dec. '07, I	0.12½
Beaver Consol.	Toronto	45	43½	45	May '20, K	0.03
Candelaria	N Y. Curb	*14	*11	*12		
Castle-Trethewey	Toronto	28	25½	28		
Coniagas	Toronto	2.65	2.60	2.65	May '21, Q	0.12½
Crown Reserve	Toronto	73	71½	72	Jan. '17,	0.05
Hilltop-Nev.	N. Y. Curb.	1 1/16	1⅛	1⅛		
Kerr Lake	N. Y. Curb	3	2⅞	3	Apr. '23, Q	0.12½
La Rose	Toronto	33¼	29	32½	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	21	19	19	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	3.10	3.00	3.00	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	5⅞	5⅛	5⅛	Apr. '23, Q	0.15
Ontario Silver	New York	7⅛	6⅛	7⅛	Jan. '19, Q	0.50
Temiskaming	Toronto	49	47½	49	Jan. '20, K	0.04

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	...	...	¼		
Alaska Juneau	New York	1⅛	1⅛	1⅛		
Carson Hill	Boston	6⅛	5⅛	5⅛		
Cresson Consol. G.	N. Y. Curb	3 7/16	3 1/16	3⅛	Apr. '23 Q	0.10
Dome Mines	New York	42¼	40	42½	Apr. '23, Q	0.50
Golden Cycle	Colo. Springs	1.08	1.07	1.08	Dec. '22, Q	0.02
Hollinger Consol.	Toronto	13.25	13.20	13.25	Apr. '23, M	0.05
Homestake Mining	New York	67½	67	67	Apr. '23, M	0.50
Kirkland Lake	Toronto	55	55	55		
Lake Shore	Toronto	3.50	3.35	3.50	Feb. '23, Q	0.02
McIntyre-Porcupine	New York	20⅛	17½	20	May '23, Q	0.25
Portland	Colo. Springs	*35	*35	*35	Oct. '20, Q	0.01
Teck-Hughes	N. Y. Curb	1 1/16	1 1/16	1 1/16		
Tom Reed	Los Angeles	*96	*93	*93	Dec. '19,	0.02
United Eastern	N. Y. Curb	2	1⅞	1⅞	Apr. '23, Q	0.15
Vipond Cons.	Toronto	*74	*72	*74		
White Caps Mining	N. Y. Curb	*8	*8	*8		
Wright-Hargreaves	Toronto	3.58	3.53	3.56	Apr. '23,	0.02½
Yukon Gold	N. Y. Curb	1¾	1 1/16	1⅛	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	*21	*15	*18		
Cons. Virginia	San Francisco	15	12⅛	12⅛		
Continental Mines	N. Y. Curb	5	4⅞	5		
Dolores Esperanza	N. Y. Curb	1⅜	1⅛	1⅛	Apr. '23	2.50
Tonopah Belmont	N. Y. Curb	1⅛	1	1 1/16	Apr. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*59	*52	*55		
Tonopah Extension	N. Y. Curb	2 1/16	2⅛	2 1/16	Jan. '23, Q,X	0.10
Tonopah Mining	N. Y. Curb	1⅛	1 1/16	1 1/16	Apr. '23, Q	0.7½
Unity Gold	N. Y. Curb	5⅛	4⅞	4⅞		
West End Consol.	N. Y. Curb	1 1/16	1	1 1/16	Mar. '23, Q	0.05
SILVER-LEAD						
Bingham Mines	Boston	17⅛	17⅛	17⅛	Sept. 19, Q	0.25
Cardiff M. & M.	Salt Lake	*72	*45	*70	Dec. '20,	0.15
Chief Consol.	Boston Curb	4⅛	4	4⅛	May '23, Q	0.10
Columbus Rexall	Salt Lake	*58	*45	*51	Aug. '22,	0.03
Consol. M. & S.	Montreal	29½	26	26½	Oct. '20, Q	0.62½
Federal M. & S.	New York	7¼	7⅛	7⅛	Jan. '09,	1.50
Federal M. & S. pfd.	New York	48	48	48	Mar '23, Q	1.75
Florence Silver	Spokane	*38	*38	*38	Apr. '19, Q,X	0.01½
Hecla Mining	N. Y. Curb	9⅛	9⅛	9⅜	Mar. '23,	0.25
Iron Blossom Con.	N. Y. Curb	*33	*30	*30	Apr. '22, Q	0.02½
Marsh Mines	N. Y. Curb	*15	*14	*14	June '21, I	0.02
Park City	Salt Lake	3.60	3.40	3.60	Apr. '23,	0.12½
Park Utah	N. Y. Curb	....	....	3⅛	Apr. '23	0.15
Prince Consol.	Salt Lake	*11	*8⅛	*8⅛	Nov. '17,	0.02½
Silversmith	Spokane	*41	*40	*40	Apr. 23,	0.01
Simon Silver Lead	N. Y. Curb	*42	*38	*39		
Snow Storm Silver-L	N. Y. Curb	1	*96	*97		
Tamarack-Custer	Spokane	1.50	1.25	1.45	Jan. '21, K	0.04
Tintic Standard	Salt Lake	3.35	2.85	3.325	Dec. '22, Q,X	0.10
Utah-Apex	Boston	5⅛	4⅞	5⅛	Nov. '20, K	0.25
IRON						
Bethlehem Steel	New York	63½	58⅛	60⅜	Apr. '23, Q	1.25
Char. Iron	Detroit	...	...	2		
Char. Iron, pfd.	Detroit	...	...	3⅛		
Colorado Fuel & Iron	New York	33⅜	29	31	May '21	0.75
Col. Fuel & Iron, pfd.	New York	...	...	102	Feb. '23, Q	2.00
Gt. North'n Iron Ore	New York	31⅜	30⅛	30⅛	Apr. '23	1.00
Inland Steel	N. Y. Curb	...	...	46⅛	Mar. '23	0.25
Mesabi Iron	N. Y. Curb	...	...	9		
Replogle Steel	New York	24⅛	21	21⅜		
Republic I. & S.	New York	61⅛	52⅛	53⅜	May '21	1.50
Republic I. S., pfd.	New York	94⅛	93	93	Apr. '23	1.75
Sloss-Sheffield S. & I.	New York	57¼	52	53⅛	Feb. '21	1.50
Sloss-Shef. S.&I., pfd.	New York	...	...	86	Apr. '23	1.75
U. S. Steel	New York	105⅛	101⅛	102	Mar. '23, Q	1.25
U. S. Steel, pfd.	New York	118⅛	118	118	Feb. '23	1.75
Virginia I. C. & C.	New York	63	61	62	Jan. '22	1.50
Virginia I.C.&C.,pfd.	New York	83	83	83	Jan '23	2.50
VANADIUM						
Vanadium Corp.	New York	37⅛	32⅛	34⅛	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	70	63	63⅛	Apr. '23 Q	1.50
Asbestos Corp. pfd.	Montreal	89⅛	85¼	86	Apr. '23 Q	1.75
SULPHUR						
Freeport Texas	New York	17	13⅛	14⅛	Nov. '19, Q	1.00
Texas Gulf	New York	62⅛	60⅛	61¼	Mar. '23, Q	1.25
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3⅛	3⅛	3		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	48⅛	45⅛	46	Mar. '23, Q	0.75
Amer. Metal pfd.	New York	...	...	114	Mar. '23, Q	1.75
Amer. Sm. & Ref.	New York	62⅜	59	59⅜	Mar. '21, Q	1.00
Amer. Sm.& Ref. pfd	New York	99	97⅛	98	Mar. '23 Q	1.75
U. S. Sm R. & M.	New York	34	32	32⅛	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York	44⅛	44⅛	44⅛	Apr. '23 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

Current Prices of Mine Materials and Supplies

RISE AND FALL OF THE MARKET

Advances—Galvanized steel sheets up 50c., f.o.b. Pittsburgh, and 10c. per 100 lb. in St. Louis. Blue annealed, black and galvanized sheets higher in New York and San Francisco. Structural steel, wire rope and wrought-steel pipe higher at dealers warehouses throughout country. Spikes, track bolts and angle bars advanced in St. Louis and Birmingham. Cast-iron pipe, 6-in., rose $2 in Birmingham, $3 in Chicago and $5 per ton in St. Louis, since last month. Hollow tile advanced in New York, Chicago, St. Louis and Perth Amboy, N. J. Hydrated finishing lime up $150 per ton, f.o.b. New York. Raw linseed oil, $1.16 in 5 bbl. lots, f.o.b. New York, against $1.13 per gal.; $1.35 in Chicago, compared with $1.25, one month ago. White and red lead, in keeping with other paint stuffs, rose ¼c. per lb. in month. Structural timbers advanced generally, except slight downward tendency in yellow pine in Boston and Chicago. Nuts, bolts and nails tending upward. Market higher than month ago on such supplies as hose, belting, rope and dynamite.

Declines—Aside from slight declines in pine timbers mentioned above, drop in price of pine oil constitutes only decline reported in mine materials and supplies.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.65@3.35	$4.25	$4.15	$4.85	$4.59
Black					
No. 28	3.50@4.00	5.00	5.00	6.15	5.15
Galvanized					
No. 28	5.00@5.75	6.10	6.10	7.00	6.15

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago
Standard bessemer rails	$43.00	$40.00	.....	$43.00
Standard openhearth rails	43.00	40.00	$43.00	43.00

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$3.15	$2.15@2.25	$3.00	$4.15	$4.85	$3.60
Track bolts	4.00@4.50	3.00@3.50	4.00	5.15	5.85	4.60
Standard section angle bars	2.75	2.40	2.75	4.00	4.10	3.00

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$2.50@2.75	$2.75	$3.64	$4.50	$3.45	$3.40	$3.85
Channel, 3 to 15 in.	2.50@2.75	2.75	3.64	4.50	3.45	3.40	3.85
Angles, 3 to 6 in., ¼ in. thick	2.50@2.75	2.75	3.64	4.50	3.45	3.40	3.85
Tees, 3 in. and larger	2.50@2.75	2.75	3.64	4.50	3.45	3.40	3.85
Plates	2.50@2.75	2.75	3.64	4.60	3.45	3.40	3.85

WIRE ROPE—Discounts from list price, f.o.b. New York and east of Missouri River, on regular grades of bright and galvanized are as follows:

Hercules red strand, all constructions	20%
Cast steel round strand rope	20%
Galvanized steel rigging and guy rope	7½%
Round strand iron and iron tiller	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%

	New York	Cleveland	Chicago
Drill Rod (from list)	55%	40@55%	50%

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

	Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
BUTT WELD	1 to 3	62	50½	⅜ to 1¼	30	13
LAP WELD	2½ to 6	59	47½	2½ to 4	26	11

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
2½ to 6 in. lap welded	49%	53½%	49%

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York Current	New York One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
6 in. and over	$58.50	46.80@47.80	$49.00	$60.20	$57.50	$60.00

Nuts—	New York	Cleveland	Chicago
Hot pressed, sq., per 100 lb. Off list	List net	$2.75	$2.50
Cold punched, sq., per 100 lb. Off list	List net	2.75	2.50

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York Current on Trucks	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory
4x12x12	$0.1573	$0.1112	$0.1032	$0.125	$0.09	$0.108	.....
6x12x12	.2097	.1667	.1496	.....	.12	.156	.....
8x12x12	.2621	.2084	.1754	.19	.165	.244	$0.2691

MACHINE BOLTS—	New York	Cleveland	Chicago
½ and 1½x3 in. up to 12 in.	15 %	50%	50%

LUMBER—Prices of rough Douglas Fir No. 1 common, in carload lots to dealers in yards at San Francisco. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$40.00	$41.00	$42.00	$45.00
3x6 and 8	40.00	41.00	42.00	45.00
4x4-6 and 8	40.00	41.00	42.00	45.00

Wholesale prices to dealers of long leaf yellow pine. To contractors in New York City, delivered from lighters or cars to job, $5 additional.

	New York 20 Ft. and Under	New York 22-24 Ft.	Chicago 20 Ft. and Under	Chicago 22-24 Ft.
3x4 to 8x8	$52.00	$53.00	$54.00	$56.00
3x10 to 10x10	56.00	57.00	57.00	59.00
3x12 to 12x12	60.00	61.00	60.00	62.00

Other Cities	8 x 8-In. x 20 Ft. and Under Pine	Fir	Hemlock	Spruce	12 x 12-In. 20 Ft. and Under Pine	Fir
Boston	$65.00	$130.00	$65.00	$65.00	$85.00	$150.00
Cincinnati	45.00	51.50	51.50	51.50	45.00	53.50
Denver	.....	43.00	43.00	43.00	.....	44.00
Minneapolis	46.50	45.75	41.50	.....	50.00	46.75
Kansas City	45.75	44.75	44.75	.....	58.75	48.75
Birmingham	38.00	.....	.....	.....	45.00	.....

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.90@3.10	$3.45	$4.20	$4.25	$3.34	$4.95
Cut	....	5.50	5.80	5.75	3.75	5.00

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York, del. by truck	$2.70@2.80	$2.70@2.80	2.40
Chicago, f.o.b.	2.20	2.20	1.97
Cleveland, f.o.b.	2.46	2.46	2.26

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel 280-lb. net Finishing	Lump, per Barrel 280-lb. net Common
New York	$18.60	$13.10	$3.75	$3.00@$3.25
San Francisco	22.00	16.00	....	(180-lb net) 1.75

LINSEED OIL—These prices are per gallon:

	New York Current	New York One Year Ago	Chicago Current	Chicago One Year Ago
Raw in barrel (5 bbl. lots)	$1.16	$0.91	$1.35	$0.90

WHITE AND RED LEAD—Base price in cents per pound:

	Red Current Dry	Red Current In Oil	Red 1 Year Ago Dry	Red 1 Year Ago In Oil	White Current Dry or In Oil	White Yr. Ago Dry or In Oil
100-lb. keg	14.50	16.00	12.25	13.75	14.50	12.25
25 and 50-lb. kegs	14.75	16.25	12.50	14.00	14.75	12.50

HOSE—

Fire Underwriters' 2½-in. coupled	50-Ft. Lengths 53c per ft.

Air	First Grade	Second Grade
¾-in., 3 ply per ft.	$0.33	$0.25

Steam—Discounts from List

First grade ..... 40-5% Second grade ..... 45% Third grade 50%

RUBBER BELTING—The following discounts from list apply to transmission rubber and duck belting:

Competition ..... 60-10% Best grade 50-10-5%

LEATHER BELTING—List price per ply, 12-in. wide, per lin. ft. $2.88.

Grade	Discount from list
Medium	30-10%
Heavy	20-5-2½%

RAWHIDE LACING—For cut, best grade, 40%, 2nd grade, 50%. For laces in sides, best, 48c. per sq.ft.; 2nd, 43c. Semi-tanned: cut, 40%; sides, 48c. per sq.ft.

PACKING—Prices per pound:

Rubber and duck for low-pressure steam, ½ in.	$0.90
Rubber sheet	.45
Rubber sheet, wire insertion	.70

MANILA ROPE—Per lb., ¾-in. and larger, 1,200-ft. coils.

Atlanta	$0.22	New Orleans	$0.18½
New York	.18½	Seattle	.18
Chicago	.18	San Francisco	.18

EXPLOSIVES—Prices per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.275	$0.30
Minneapolis	.1967	.2173
Denver	.2075	.2325
Seattle	.165	.195
Cincinnati	.22	.25
New Orleans	.252	.285
San Francisco	.1625	.1925

FLOTATION OILS—All prices are per gal. in carload lots; 50-gal. bbls., gross weight 500 lbs.

Pine oil, steam dist., f.o.b. New York	$0.80
Pine oil, pure, dest. dist. f.o.b. New York	.75
Pine tar oil, ref. f.o.b. New York	.48
Pine tar oil, crude, tank cars f.o.b. Jacksonville, Fla	.32½

CHEMICALS—

Zinc dust, 550 lb. casks, f.o.b. Palmerton, Pa., per lb.	$0.10
Litharge, delivered New York, l.c.l., casks, per 100 lb.	10.90
Sodium cyanide, 220 lb. cases, f.o.b. New York, per lb.	0.20@0.21

NEW MACHINERY AND INVENTIONS

An Electric Blasting-Type Ohmmeter-Galvanometer

Electric blasting operations have been conducted on a more or less hit-and-miss plan for want of a simple, convenient, accurate, and safe instrument for determining the actual electrical condition of the blasting circuit and of the elements (the blasting caps and the wires) comprising the circuit. A direct-reading ohmmeter is the most convenient means of measuring resistance quickly, but the standard types which are on the market are so constructed that without some modification it would be dangerous to use them in measuring electric blasting caps. The California Cap Co., in collaboration with the Roller-Smith Co., electrical instrument makers of New York, has designed and is offering to the users of electric blasting supplies a direct-reading electric blasting type ohmmeter-galvanometer, which combines in one instrument an ohmmeter for the direct determination of numerical values of the resistance of a blasting circuit and a galvanometer for the rapid determination of continuity of circuit, or for detection of opens, shorts, and grounds.

To use as an ohmmeter, it is necessary merely to connect the resistance to be measured, slide the stylus along the instrument wire until the point of balance on the galvanometer is reached, then to read the resistance in ohms directly on the calibrated scale. To use as a blasting galvanometer, the stylus is touched to the contact point marked "open circuit" and the pointer on the galvanometer dial observed.

The numerical value of the resistance in ohms, that value to be ascertained directly without calculation, is desirable from two standpoints, namely:

1. The total resistance of a blasting circuit is the governing factor of the magnitude of the current flowing through the circuit. It is a factor obtained accurately only by means of an ohmmeter. It is too often neglected and yet frequently it is the cause of failure that apparently cannot be explained. A reduction in current, due to excessive external resistance, results in misfires, which are more difficult to cope with than if the entire round had failed, because surrounding ground has been disturbed and wires have been destroyed, necessitating drilling new holes and the making up of a new round.

2. By comparing the resistance of the circuit at different times, it is possible to determine the development of any condition leading to a leakage of current. For example: If at one reading the entire circuit registered a total resistance of, say, 50 ohms, and a few hours afterward, upon taking another reading, it was found to be only 25 ohms, it is evident that this reduction in value is caused by the current from the instrument leaking through the earth. The firing current would, of course, take this path instead of the one through the caps.

When an entire round fails, the fault is usually due to a broken bridge or wire. Broken circuits could be readily located and corrected before any attempt were made to fire the round, if a galvanometer were used systematically.

It is claimed that the combining of galvanometer with ohmmeter in one instrument makes for convenience in carrying and operating. It also saves time; it utilizes the one battery and indicator dial for the twofold purpose; and the two-in-one instrument makes possible the use of the ohmmeter for a more accurate reading of resistance, and also for detecting some cases of leakage which the ordinary blasting galvanometer, if used alone, is not sensitive enough to detect, and which might otherwise be detrimental to the successful firing of a round.

The new instrument is of the Wheatstone-bridge type, 9½ x 4⅝ in. square in cross section, weight 5½ lb. Metal parts are nickel-plated, and the instrument is enclosed in a polished wooden case, provided with a leather handle.

Calibrated to read directly in ohms, there are three scales, 0 to 1, 0 to 10 and 0 to 100, for use according to the values of the unknown resistance and the accuracy of the reading desired.

The slide wire is divided into two parts, connected electrically. This reduces the length of the case, but at the same time provides wire long enough to give sufficient accuracy. Contact is made by means of a stylus, which also contains the battery switch, so that they may both be operated with one hand.

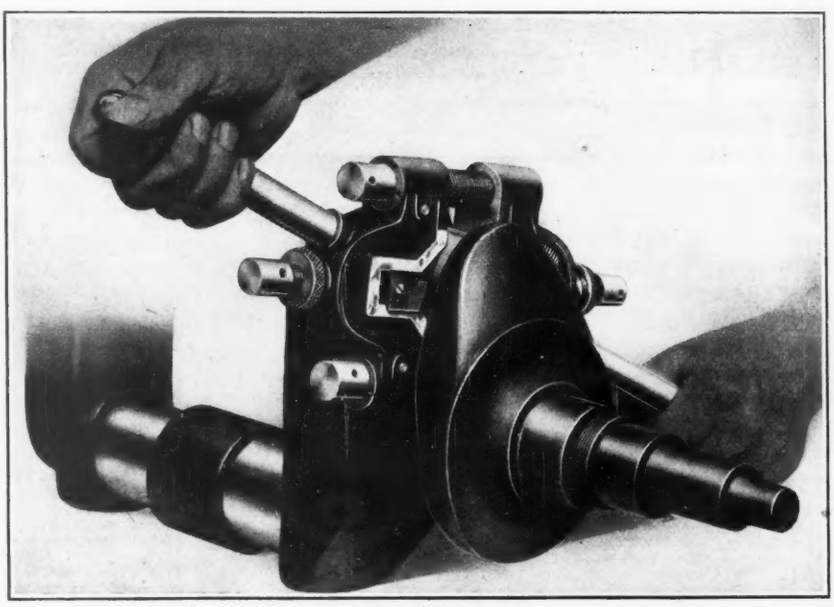
The galvanometer is placed in the center of the instrument and the distance of the scale below the glass is such that the galvanometer can be easily read. At the side of the galvanometer is an open circuit button. By means of this button the instrument can be used for the determination of continuity of circuit, so that the device serves both as an ohmmeter and galvanometer. It is the addition of this feature which has the effect of embodying two instruments in one.

The battery employed is a silver chloride cell which does not deliver sufficient current to fire an electric blasting cap. Using a cell of this kind and the ballast resistance which has been introduced into the battery circuit gives a large factor of safety over the amount of current required to fire an electric blasting cap. Replacement is easily effected by removing the battery cover in the back of the case and inserting a new cell. No connections are required to be made, as the terminal posts are held by means of spring clips, which also make the contact. The battery is held in place by means of a spring clip. It is only necessary to see that the positive post is in the clip marked "Positive."

A word of caution is given against using any other ohmmeter or galvanometer for determining electric blasting resistances and circuit conditions unless specifically labeled for electric blasting purposes, because other types employ currents that are strong enough to fire electric blasting caps under conditions that may result disastrously.

A New Crankpin Turner

A new tool developed by a New Jersey manufacturer is useful in truing bearings and shaftings by hand and should be found of service in many small plants where there is not enough of such repair work to warrant the purchasing of more complicated equipment. It is claimed that this tool will turn round within one-thousandth of an inch. It has a capacity of from 1¼ to 2½ in. in diameter. It is manufactured by Krauter & Co., 565 Eighteenth Ave., Newark, N. J.



New crankpin turner